THE

ELECTRICAL REVIEW.

VOL. LXXVII. DECEMBER 31, 1915. No. 1,988.

ELECTRICAL REVIEW.

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NOTICE.

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1915.

THIS issue of the ELECTRICAL REVIEW appears on the last day of the year—a year, we think, whose demise will be observed without regret by the vast majority of our readers, for truly it has been marked by few auspicious events, but many failures, reverses, misunderstandings, and the like. Of the war we shall say nothing, lest, like the military "experts" whose forecasts are daily falsified by the event, we trespass beyond the limits of our knowledge; we shall content ourselves with uttering the fervent hope that 1916 will see the end of it, and the forces of the Allied nations crowned with victory, crushing and complete.

In accordance with our custom, however, we propose briefly to review the events and tendencies of the past year so far as they affect the engineering industries in general, and the electrical industry in particular; and foremost amongst these we are disposed to place the evidences that the nation is being gradually aroused to a sense of the importance of adopting scientific method in every branch of industry. The appointment of an Advisory Council on Industrial Research by the Board of Education, which was followed by the institution of committees to report on inventions for the Admiralty and the Ministry of Munitions, was an epoch-making event, and though no striking results have as yet been manifested openly, we know that the Council is busily engaged in the preliminary work which is indispensable to the success of its future operations. As we have pointed out, the necessary reform cannot be effected purely by the fiat of the Government; the support of the nation to the new policy is essential to success, and not a moment should be lost in completing our preparations for the return of peace and the outbreak of the industrial war.

The inexorable demands of the War Office for soldiers, and the Ministry of Munitions for skilled workmen, have weighed heavily upon the engineering industries, and have clashed with the call for maintained exports on the part of the Board of Trade; the question whether to comply with the one or the other has been the subject of anxious consideration on the part of electrical manufacturing companies. "Business as usual" has proved to be impossible, and work is being carried on under very unusual conditions indeed. The directors, however, are in close touch with the authorities concerned, and every effort is being made to fulfil all three of these conflicting demands; women, who have played a most unexpectedly prominent part in the maintenance of industry, have been very largely employed, and the skilled men have been "diluted" by the increased use of

unskilled labour, with the grudging and suspicious assent as a rule of the members of trade unions, many of whom, with a remarkable narrowness of vision, seem more concerned as to their personal welfare than as to the safety of the Kingdom.

An unforeseen feature of the war work has been the extraordinary activity of the electricity supply stations of the country, at any rate those engaged in supplying industrial areas; their output has increased by leaps and bounds, new plant has had to be installed as quickly as possible, and temporary stations —including one of 10,000 KW.—have been erected and put to work in order to provide motive power for factories manufacturing munitions of war. The extreme importance of our electricity works in this emergency has compelled recognition, and it is certain that the extended use of electricity during the war will have a permanent beneficial effect upon the supply industry.

Another consequence of war conditions is the shortage of arc lamp carbons, which has compelled many street lighting authorities to install half-watt lamps in place of their existing arc lamps, thus giving an unexpected impulse to the adoption of the new lamps. In this connection, though quite apart from the influence of the war, we may again refer to the introduction of the Ediswan tungsten arc lamp, a product of British research from which important developments may result.

The linking-up of the various undertakings supplying electricity to the Metropolitan area has made considerable progress during the year, and will in normal times result in a more reliable service at lower cost; the war, however, indirectly led to the abandonment of the scheme of the London County Council for the unification of the supply to London, the necessary majority being unavailable owing to the absence of members on military service.

In the department of electric traction, the most notable event was the successful inauguration of the electrified system of the London and South-Western Railway Co. on part of its suburban lines; additional sections will soon be in running order, and it is hoped that next year the London and North-Western Railway will be added to the list of electrically operated undertakings. The Manchester-Bury line of the Lancashire & Yorkshire Railway Co. is also practically complete.

Lastly—for space is limited—we may permit ourselves a note of gratification with regard to the splendid progress that has been made by the electric-battery vehicle in this country during the past year. For many years, in season and out of season, we urged upon our readers the practicability and desirability of fostering the adoption of the commercial electric vehicle in British towns; eventually the Municipal Electrical Association awoke to the prospects in this field, and appointed a committee which has done admirable work; and now we are able to say that the number of electric vehicles in use or on order is approaching 700, as compared with 150 a year ago. It will not be many years before we announce that the number is approaching 7,000.

Aircraft Insurance.

We read that the Committee on War Damage, which is backed up by nearly a hundred municipalities, is memorialising the Prime Minister, strongly condemning as unjust, as well as inexpedient, because it is wasteful in time and energy, the present Government scheme for insurance against damage by aircraft or by bombardment. The memorialists hold that individual citizens should not be held responsible for damage inflicted upon them by the enemy, but that the nation, as a whole, through the responsible Government, should give a fair compensation to owners of properties of all kinds. We believe that this sentiment is subscribed to by very large numbers of public and private individuals, who consider that the present scheme operates unfairly, because it throws upon certain sections of the community—namely, owners, lessees and occupiers of business and residential properties—burdens and responsibilities which should be shared by all. It was stated a few weeks ago that arrangements had been made to compensate, out of the Prince of Wales's Relief Fund, some of the poorest people who were the victims of the last raid by enemy aircraft. Failure to pay insurance premiums involves the penalty of non-compensation so far as the State is concerned, but if you are poor or deserving enough you may be assisted from a voluntary source, which is, in reality, a National Fund. It is not to be supposed that owners of large works or mansions outside the imagined range of enemy aircraft will pay premiums purely for the sake of assisting those whose geographical ill-luck brings them within the danger-zone. They may, perchance, discover that their imaginations as to the real range are incorrect, and, having failed to insure, will reap disaster. On the other hand, if the range does not extend, one part of these islands must bear the burden alone. The risk and the loss are those of the entire nation at war, and the financial obligations should be distributed amongst us all. We hope that the Committee will be able to demonstrate to Mr. Asquith the inequity, the inexpediency, and the unpopularity of the present system.

British Co-operation in Russia.

We welcome very heartily the registration of the Electrical Manufacturers' Co., of Great Britain, Ltd., which is announced in another part of this issue. It has been clear for a long time past that co-operative action between a number of our firms was needed if the British electrical industry was to be in a position to benefit to any particular extent from the unparalleled opportunity opened out for us in Russia by the war. We congratulate the seven well-known firms who have launched this joint enterprise for carrying on business in that vast market. Other organisations which have adopted the co-operative principle in other branches of engineering trade have enjoyed excellent success in Russia already, and we believe that there is a splendid opening for the seven concerns which have representatives on the board of this new company. We wish them every success, and expect to witness the further application of the same policy of combined action both in the Russian market and in others as well, as one of the good results of the war. The capital is not large when one considers it in comparison with that of Teutonic organisations, but we have to remember that it is but a beginning, and we trust that the effort will lead to very substantial profit and developments.

The Decimal System.

We have received from M. H. Planchon a further (very long) letter with regard to the adoption of decimal coinage in this country, in which he raises objections to the retention of the pound, and champions the cause of the shilling divided into 100 parts; Mr. Turnbull also has sent us a lengthy communication on the subject, advocating the adoption of a coin equivalent to the franc. We are very much indebted

to our correspondents for their very practical support of our main contention—namely, that the adoption of decimal notation throughout our systems of coinage, measures, and weights is a question of most urgent importance to the future welfare of our industries—support which we cordially appreciate.

We have to bear in mind, however, that this is a technical journal, and we cannot pretend that the detailed discussion of rival systems of coinage is within our legitimate sphere of operations. We have stated that the adoption of the metric system—which is a matter closely affecting engineers—is, in our opinion, far more important than the coinage question, and while we have devoted many pages to the former, we have only briefly set forth our views on the latter. In accordance with this policy, we are regretfully obliged to decline to open our pages to a general discussion on decimal coinage systems.

In two new specifications just issued by the British Engineering Standards Committee, we note with interest and pleasure that the metric equivalents of all the British standard dimensions are given, in parentheses. This practice has been followed for some years by the American Institutes of Electrical and Mechanical Engineers, by way of preparation for the change-over, and might be copied with advantage by British engineering institutions.

Mostly, the equivalents are carried to the nearest hundredth of a millimetre, which, as we have shown, affords an ample degree of accuracy far beyond what can be attained under workshop conditions, the maximum departure from identity being only $\frac{1}{2}$ mil; but, in some cases, the Standards Committee carries the figures out to thousandths of a millimetre, *i.e.*, to an accuracy represented by 0·00004 in. or $\frac{4}{100}$ of one mil. The National Physical Laboratory states that an accuracy of half a mil, or nearly 13 times the value suggested by the Standards Committee's figures, is rarely attained in the workshop, even by its own experts. Moreover, these exiguities of measurement occur only in connection with the definition of limits between which the dimensions may be varied at pleasure—ranges of two to five mils! With due respect to the Committee, we suggest that the needs of the case would have been more than covered with the nearest hundredth of a millimetre throughout—the maximum possible error in that case being beyond the range of workshop practice.

Some indication of the growing demand for the early adoption of the metric system will be found in a Note elsewhere in this issue.

The Monopoly Question in Germany.

This question was referred to at the recent meeting of the Berlin A.E.G., when Dr. Walter Rathenau remarked that he did not consider himself sufficiently competent to give a definite opinion as to whether an electricity supply monopoly would, or would not, be brought into existence. In his view, however, the monopolisation of electric power, as such, was out of the question and impracticable, as electric power must remain the first power for working in the future. But a monopoly of electricity supply for lighting was also scarcely probable, and, he might say, not practicable. On the other hand, approval could be given to the principle upon which the kingdom of Saxony was proceeding in connection with the Government scheme for the utilisation of electric power. This principle aimed at the supply of electricity being left in the hands of the State for the working of the main railway lines, whilst the requirements of the secondary railways and the tramways were to be reserved for private industry. The kingdom of Bavaria had also expressed itself in favour of this principle, and the speaker hoped that the measures to be expected in Prussia would likewise be conformable to the principle, and that the price of electric supply would not become dearer as a result of future legislation. On the other hand, reports issued from Dresden since the meeting of the A.E.G. declare that the local authorities in Saxony, which own electricity works, are disturbed at the proposal of the Government to nationalise the supply of electricity as they apprehend that their independence in the supply of light and power would be endangered. The local authorities have therefore given united expression to their distrust of the proposal, but they are prepared to combine with the State in the supply provided that the State does not have a preponderating position in such an association. It appears, moreover, that the Union of Municipal Electricity Works in Saxony has had plans prepared for some time past for meeting the requirements of the kingdom by the erection of large overland stations.

Rubber.

There has been a decidedly good undertone lately in the rubber market, and there has been some tendency, indeed, towards an improvement in values so far as plantation descriptions are concerned, while there has been rather a better demand for Brazilian grades, although the quotation for fine hard Para is, of course, at a fair discount compared with the best plantation material. The tone has undoubtedly been assisted by the situation of shipping in the Mediterranean and the risks to which vessels are exposed in navigating those waters. Consumers have purchased rather more freely, and it is believed that there is a fair amount of buying yet to be done in connection with orders for finished material which have been placed upon the books. The inquiry has been pretty general both for early and forward deliveries, and the outlook for every description remains good. It is possible that there may be a slackening off in new inquiries with the turn of the year, but this is regarded merely as a seasonal feature. America has within the last week or two been inquiring for big quantities, and this has naturally tended to assist the firmness of the market. The arrivals coming to hand have been quite moderate, and the statistical position is regarded as satisfactory. Last month the stocks were further reduced by 228 tons, to a little over 7,000 tons, against about 5,000 tons a year ago, and 6,000 tons in 1913. American consumption is proceeding at a very high rate, and this point should not be disregarded in considering the possibilities of the future. There was a good deal of talk a short time ago about Germany buying large quantities of rubber in America, but a good deal of this seems to have been without substantial foundation, though it is a fact that the parcel post between North America and certain of the European neutral countries has been very extensively used for the conveyance of rubber to the Central Powers. Steps have been taken, however, which will probably put a stop to this, except upon any but the smallest scale. An official cablegram received from Kuala Lumpur reports that the export of plantation rubber from the Federated Malay States during the month of November amounted to 4,636 tons as compared with 4,120 tons in October and 2,889 tons in the corresponding month last year. The following is a comparative table showing the export for three years.

	1913.	1914.	1915.
January	2,131	2,542	3,473 tons.
February	1,757	2,364	3,411 ,,
March	1,737	2,418	3,418 ,,
April	1,626	2,151	2,777 ,,
May	1,225	2,069	2,708 ,,
June	2,005	2,306	3,403 ,,
July	1,781	2,971	3,687 ,,
August...	2,363	1,850	3 796 ,,
September	2.000	2,879	3,984* ,,
October	2.160	2 897	4,120 ,,
November	2,062	2,889	4,636 ,,
Total	20,847	27,336	39,413 ,,

* In the original statement for September, the total exports were returned at 3,334 tons, or 650 tons below the actual amount, as now corrected.

DIRECT-CURRENT MOTOR MAINTENANCE.

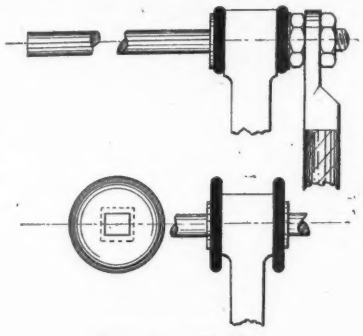
By S. LEES.

The successful operation of direct-current machinery may be summed up in two words—*efficient maintenance*. Cleanliness is of course an important factor, although it is not impossible to interpret the meaning thereof too liberally, as in the case of the over-zealous attendant who, in his laudable endeavours to make the bright parts shine, applied the polishing medium so lavishly that the brush-holders became jammed fast with the superfluous mixture. Nor does the term apply only to those parts that are always visible to the eye, to the neglect of those which are not quite so conspicuous, such as the brush-gear on the underside, that comes to grief through the cumulative effects of deposited grease and carbon dust.

In the majority of cases of breakdown and failure the principal operating cause is very simple—namely, "dirt." In its present application the word "dirt" is meant to cover any foreign substance or matter which by its presence or proximity may have a deleterious effect on the working of electrical apparatus. As an example: ordinarily one looks upon milled cereals as being of clean and impeccable character. Now, motors working in a flour mill will in the ordinary course of things get coated more or less with dusty matter floating in the atmosphere, which, contrary to the generally accepted notions of maintenance men, is positively harmful to the well-being of electrical machinery. Grain, especially in the milled state, is a notoriously bad heat conductor, and even a comparatively thin deposit of such flour-like dust may cause a motor armature or field coil to become dangerously over-heated. Again, such conditions sooner or later become favourable to the leavening action which takes place under hygroscopic or oleific combination. Slowly, it may be, but surely, the insidious deterioration of the protective insulation goes on until the inevitable breakdown happens. So may we for our purpose classify clean edible flour as "dirt."

Similarly in woodworking shops, dry sawdust in itself is harmless enough, but, nevertheless, this substance must be regarded as more than a potential foe. An unheeded accumulation of grease-soaked sawdust that had subsequently become carbonised, has proved to be the undoing of many a good motor. The presence of dry coal-dust also augurs ill for the good working of either motor or switchgear; in combination with oil it is certain to cause trouble quickly, the effect of such a mixture on insulation being exceptionally destructive.

The writer has observed that plant in engineering works, including central stations, is peculiarly prone to trouble due to breakdowns and failures of various kinds. More shabby makeshifts and temporary expedients are to be found in high than in lowly places. The ubiquitous grease lump inseparable from the shop or station ought to be shunned like the plague. It seems strange that while the storekeeper guards waste, wipers, and the like, with mint-like vigilance, requisitions for comparatively valuable stock and material are commonly honoured with surprising ease. Lubricating oil comes within the latter category, and the oil-can or feeder, like the widow's cruse, never need run dry. Those so-called minor insulation troubles, such as breakdown of brush-holder insulation, failure of mica or mica substitute between commutator-bars or clamp-rings, perishing of field-coil connections, and "shorting" of outer turns of field windings, which develop later into absolute breakdowns, oftener than not have their origin in the thoughtless use of the oil-feeder or greasy wiper. In addition to the deleterious effect of oil on insulation, an oily surface acts as an excellent dust-arrester on the fly-paper principle. Then does insulation become measureable by a different arithmetic, not so much the volts necessary to puncture a given thickness, as the comparatively low pressure (backed by power) required to break down the surface security of an otherwise good enough insulator. The insulation of brush-holder spindles and brush arms, especially the bottom or underside sets, is commonly attacked and broken down in the manner described. Closer attention might with advantage be given to the mechanical features of brush-holder insulation by designers. Motors, especially those of the protected or enclosed type, are notable examples of weakness in this detail. It is quite a common thing to find only a very small fraction of an inch of insulating surface separating "live" metal from the earthed carcase of a high-voltage motor. It is very rarely that failures of insulation due to pure puncturing occur on direct-current up to 600 volts, the trouble, even with the best classes of material, being almost invariably due primarily to surface leakage. A commonly-used form of insulator for a brush-holder spindle is shown in fig. 1. (*a*) Usually, the flanges are almost surface flush with the metal brush rocker, thus providing a very short and easy path for leakage. A larger flange (fig. 1*b*) is a simple but effective improvement giving, as it does, greater security against breakdown from "creeping." Curiously, though, a really adequate size of flange is the exception



Figs. 1*a* and 1*b*.

rather than the rule. The type of brush rocker represented at fig. 2 is extensively used. The open slot provides facility for the insertion and withdrawal of the brush-spindle and its insulation, and allows of the use of some form or other of moulded insulator, which has the additional advantage of cheapness. It is evident that the tightening of the spindle-shank by means of its nuts comes, after a certain point of compression is reached, wholly upon the insulator itself, particularly at some point or other of the sharp-angled junction between the core and flanges. Consequently, trouble is common at this point, as the insulator being of a more or less brittle and friable nature fractures, and thus becomes an easy prey to the insidious action of oil and carbon or copper dust. Built-up insulation, preferably of sound mica, with allowance provided on the core for the necessary tightening of

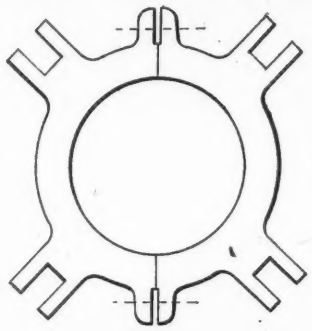


Fig. 2.

the spindle, should always be used instead of the moulded variety, and the importance of extremely close-fitting joints cannot be over estimated.

Whilst on the subject of brush-holder insulation, a few remarks about the brush-spindle itself may not be out of place. Formerly, spindles of round section throughout were used by practically all makers, but as the disadvantages of the round shank came to be better realised, the square spindle came into favour. Considering that the older practice in now obsolete, the writer was surprised some little time back to see an otherwise modern installation of big-powered multipolar motors, all of which were fitted with brush-spindles of round section throughout their whole length. Each spindle carried about a dozen sets of carbon

brushes in separately-attached holders, and owing to the great length of the spindles a special insulated steadying ring was necessary for ensuring alignment of the inner ends of the spindles. The introduction of this feature rendered the design unusually bad, as the steady ring, of necessity, occupied space already none too commodious, with the result that the whole of the brush gear was very cramped, making inspection and adjustment difficult, if not impossible, at some points. As if to crown all, the brush leads were attached to the spindles, as shown in fig. 3. Obviously,

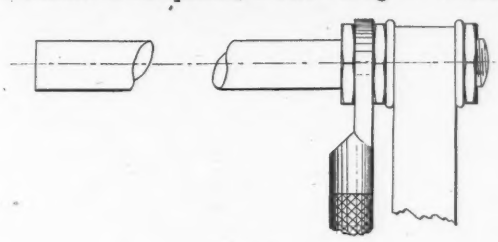


Fig. 3.

the removal of a lead would prove an awkward operation, as it means the dismantling of the whole of one section (at least) of brush-holders before disconnection could be effected. It is, indeed, hard to see what useful object the designer could have had in his mind when passing such an inconvenient arrangement. A weak design still in vogue is outlined in fig. 4. The insulation used is mica or its sub-

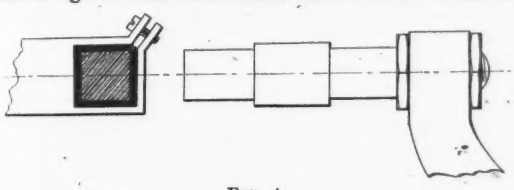


Fig. 4.

stitute, loosely bent or pressed round the iron bolt which is nutted at both sides of the brush-rocker arm. The *earthed* spindle in itself is enough to warrant condemnation of this design of gear. In the large sizes of motors the design of brush-gear closely follows that of the generator type, of which the bracket construction, or some modification thereof, is representative. The brush-holder arms or brackets are usually made of cast-iron, and attached to a divided bracket ring, which is carried in journals or similar guides fixed to the machine yoke. Trouble is often experienced from failure of the insulation between the brush arms and bracket ring. The part usually attacked first is the edge of the insulating plate, and the cause is surface leakage due to the presence of grease and carbon dust. The simple expedient illustrated at (*a*) fig. 5, is an excellent insurance

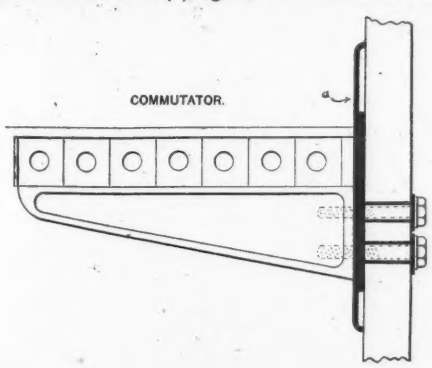


Fig. 5.

against trouble of this sort. Many years ago, Messrs. Siemens used a form of brush-holder and arm which was totally encased in a moulded envelope of insulating material. The writer had some experience of this gear, and does not remember a single case of failure or trouble of any sort resulting from its use, even where the working conditions were unusually severe. More recently, another well-known firm has adopted a modification of this construction. In this case the end of the brush-spindle, where attached to the brush-rocker, has an insulating sleeve or block moulded solid on its metal shank. This arrangement makes a strong mechanical attachment, and provided the insulating material is right, results in a thoroughly sound job.

Probably in no auxiliary detail of the modern motor does greater diversity of design and fixture exist than in the arrangement of cable terminal attachments. Thus we find terminal blocks fixed to the outside of the yoke shell in all manner of places; others have simply binding post screws protected by thin apologies for insulation bolted directly to the motor case; many are located beneath the commutator, and whilst some are hidden away inside the inner recesses of the motor, in not a few designs the cable leads are simply connected through, the conventional pot-ware or wood terminal block being altogether dispensed with. Undoubtedly, the worst place to thread through cables in an electric motor is at the bottom side of the commutator end cover or bearing bracket. Oil and grease invariably accumulate at this point, and attack the insulation alike of

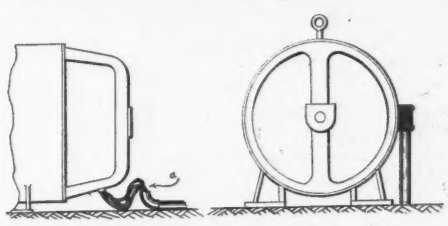


Fig. 6.

cable and terminal block. One well-known make of motor has its terminal binding posts located in the channel-shaped recess formed at the bottom of the commutator end bracket. Trouble from breakdown of insulation is so common that, in a recently issued design of this make, the arrangement of this detail has been radically altered. Comment is, perhaps, unnecessary on the too-frequent practice illustrated at *a* in fig. 6.

The highest possible class of wiring system, properly erected with protective devices *ad lib.*, avails but little if the safety of the whole job depends on the integrity of a few inches' run of uncovered cable. The practice of leaving a bundle of exposed cables between the end of the service

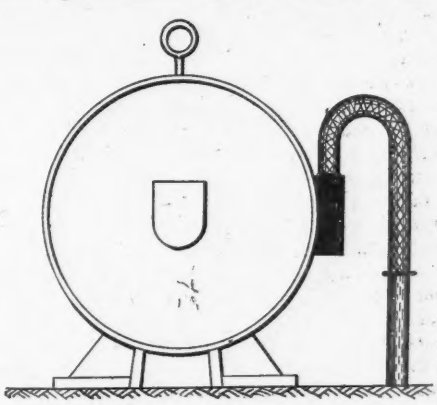


Fig. 7.

leads and the connected apparatus is to be condemned. Of course, a few spirals of wire symmetrically disposed may give a nice finish to a job, but this sort of adornment is better confined to bell-wiring and the like. If it is impracticable to attach the conduit itself mechanically to the motor, then some other equally suitable method should be devised. A strong and neat substitute is available in the numerous forms of flexible metallic tubing, one adaptation being represented in fig. 7. A flagrant case of exposed leads was met with by the writer quite recently. A modern totally-enclosed, type of motor, with a name, had its connecting cables (unarmoured) between the external terminal block and the windings *outside* the case. Another machine, similar to the last-mentioned, had a specially arranged aperture cast in the commutator end cover through

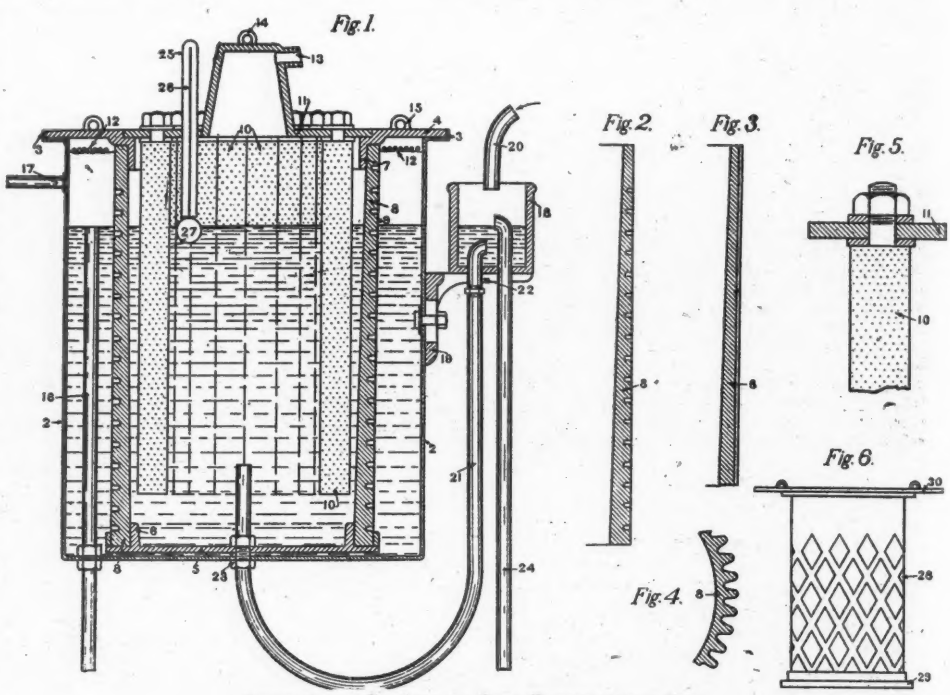
which the armature and field leads were threaded after leaving the terminal box attached to the side of the motor shell. The still prevalent practice of placing jointed and similar connections in awkward or inaccessible positions cannot be too strongly condemned. With modern designing resources there can be no necessity for this, and, in fact, every connected (electrical) detail can, by suitable disposition, be located so as to be accessible for handling without introducing undue risk of harm either to operator or machine. It may seem a trifling detail, but small size hexagonal-headed screws may with advantage be provided with cruciform slots.

The initial installation of a machine often of necessity carries with it difficulties in the way of setting-up and what not, but rarely does expedient fail to secure the completion of even an unusually stiff job. Doubtless, at times, work, especially when contract, is rushed through by hook or by crook, as the saying goes, much of which might have been avoided and more scrupulousness used had the machine not "worked in so cussedly." But experience has long taught that it is not so much the getting in of a job which proves the ultimate criterion of its real service, as the getting out thereof, which, in the course of things mutable, must be considered inevitable. The cases innumerable of motors unnecessarily, or unsuitably, placed in inaccessible positions, would defy cataloguing. Ignorance, carelessness, lack of foresight, and amateurish rule-of-thumb have variously contributed to the failure of such schemes, and, in the fulness of time, the inevitable repair or overhaul becomes necessary. Obviously, such errors are costly, often doubly so, as in many cases subsequent re-lay-out of the plant is out of the question, and so the blunder has to be put up with in the best way possible, the mischievous effect of which falls almost wholly upon the maintenance man. For instance, imagine a big-powered motor cramped up against a right-angled corner, with its commutator end next the walls, one inspection door, or grid, capable of being opened (with careful negotiation) half-way, the other one having to remain closed owing to exigencies of space. Or, take the case where a wall brick had to be removed to make room for the terminal block side fixed to the yoke shell. This absurd arrangement necessitated the withdrawal of the whole motor, which was on a fixed bolted foundation, in order simply to disconnect the service leads. Another case was that of a foundry where a motor was located in a pit roughly dug out of the sand floor, a wooden trap-door being placed over the opening for protective purposes. Armature failures became a frequent occurrence, and bearing seizures were common. Owing to the confined space in which the motor was placed, the commutator and brush-gear were practically ungetatable, and the whole machine had to be removed bodily for withdrawal of its armature. As might be expected, the cavity was always more or less filled with foundry dirt. A cotton spinning mill had had some of its machinery in the earlier processes converted to electric driving, the motors being completely encased in wooden housings. The conditions of working were such as usually obtain in this class of textile work; and the effects of high atmospheric temperature and humidity soon rendered necessary the provision of effective ventilating arrangements. Such obvious conditions make blunders of this kind inexcusable in the eyes of possible converts, who are thus often prejudiced against electric driving. An oversight of this character may easily prove a very costly matter eventually, as the application of an efficient ventilating scheme of the kind mentioned calls for expert knowledge, and may, indeed (considered financially) be almost of equal importance to that of the plant installation, which it serves in the capacity of accessory.

(To be continued.)

ELECTROLYTIC ALKALI MANUFACTURE IN CANADA.

Although Canada has considerable salt deposits, her salt industry, at present confined to the Province of Ontario, is of very limited extent. Nevertheless, she already possesses a plant for the manufacture of caustic soda and bleaching powder by the electrolytic method. This plant, the property of the Canadian Salt Co., has been in operation since 1911 at Sandwich, Ontario, and it is described in a report on the Salt Industry of Canada issued by the Government Department of Mines.



Section and Details of Gibb Electrolytic Cell.

The cell employed for the electrolysis is a modified form of the Gibb type, and its construction is shown in the accompanying figure. The cell itself (2) is built of cast steel, and the diaphragm (8) is said to be of asbestos, although in all probability a mixture of asbestos with some other substance is used in practice. A feature of the diaphragm is that its walls increase in thickness from the top to the bottom of the cell (fig. 2), so that the increase in permeability is compensated by the increased hydrostatic pressure. The cathode consists of a metal jacket placed round the diaphragm, with a number of projections embedded in the diaphragm. It may be either perforated (fig. 6) or corrugated (figs. 3 and 4). This enables the products of electrolysis to be forced into the cathode chamber and out of the sphere of electrolytic action. The anode is made up of a ring of carbon rods (10) which project through the dome of the cell (11), in which there will be noticed the gas outlet (13). It is claimed that the use of the jacket

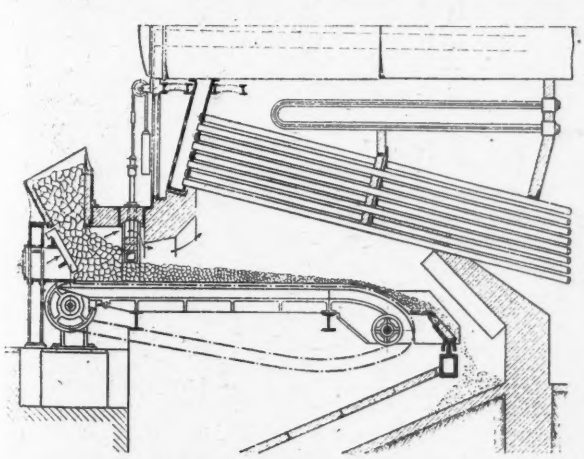
cathode embedded in the diaphragm maintains the permeability of the diaphragm for an indefinite period, for while a certain amount of disintegration goes on on the outer side owing to gas evolved, the diaphragm builds up on the inner side. Further, the intimate contact between the anode liquor and the cathode insures a complete action of the nascent hydrogen at such points, and this destroys any small percentage of deleterious hypochlorite which is often present in the final liquor.

In the cathode cell the sodium primarily deposited of course at once reacts to form caustic soda solution, which is concentrated in vacuum pan evaporators and purified until pure caustic soda results. The chlorine gas produced in the anode chamber is led into bleaching chambers, where it reacts on hydrated lime to form bleaching powder. The products find a ready market in Canada.

The plant at Sandwich consists of 256 Gibbs cells, and they are worked from a 550-kw. Westinghouse generator, which gives 2,500 amperes at 220 volts. As the cells are stated to be arranged in eight rows with 32 in each row, it is to be presumed that each cell consumes 312 amperes at just under seven volts.

COKE AS A BOILER FUEL.

Owing to the shortage of labour (probably as much potential as actual) and the closing of various foreign markets, energetic measures have been taken in Germany to prevent the possibility of a serious coal famine and to utilise huge quantities of coke which would normally be exported. These measures have attained a considerable degree of success, and from various reports it appears that a number of German electricity supply stations are using coke for boiler firing. Where a mixture of coal and coke is used, no particular trouble is experienced beyond that of obtaining and stoking a reasonably uniform mixture of the two fuels, but the use of coke alone is a less simple matter, particularly if machine stokers be used. It is impracticable to break and grade coke so that it can be used satisfactorily in sprinkler stokers, whilst if it be attempted to use coke alone on a travelling grate the difficulty is to ignite the gas-free fuel as it enters the combustion chamber. Normally, heat from an incandescent arch of refractory material over the point of entry of the fuel, frees gases from the latter, and these gases burning with a long flame keep the arch hot, and thus render the whole action of ignition continuous once it is started. With a fuel



Section of Coke-burning Furnace.

such as coke, free from volatile gases, this action fails and the fuel ignites late and imperfectly, if at all, as the grate advances.

An ingenious method by which this difficulty has been overcome is shown in the accompanying illustration (from *Z.d.V.d.I.*). The lower part of the coke-feed hopper is lined with refractory bricks and fitted with an inclined grate at the front and a flue at the back leading into the combustion chamber of the boiler. There is thus formed a hopper furnace which preheats the fuel above it, and brings it to incandescence before passing it on to the travelling grate. The greater part of the heat which is not usefully employed in this direction passes beneath the boiler, and is there utilised. This equipment, which is due to Belani (Essen), is said to have been tested with satisfactory results on a water-tube boiler in the Düsseldorf Elektrizitätswerke, though, owing to some mishap during the coal-firing tests, all that could be established was that the results with coke firing were more favourable.

Other tests, this time on a boiler with ordinary horizontal grate, showed that coke may be literally a better fuel than coal of higher thermal value. The heating surface was 1,680 sq. ft., and a flaming coal of 13,000 B.Th.U. calorific value raised 3.4 lb. of steam per hour per sq. ft. of heating surface, or 6 lb. per lb. of coal; on the other hand, coke of 12,600 B.Th.U. per lb. (size ranging from dust to 2¾ in.) raised 3.8 lb. per sq. ft. of heating surface, or 6.6 lb. per lb. of coke. The highest measured combustion chamber temperature and the flue gas exit temperature were respectively 1,220 deg. and 376 deg. C. with coal; and 1,145 deg. and 473 deg. C. with coke. The paradoxical superiority of the coke is due to its requiring a smaller surplus of air for combustion and suffering no loss from unconsumed gases or tar. On the other hand, it must be remembered that the preceding data evidently refer to anything but a modern high-power boiler, and no mention is made of the relative costs of coal and coke as boiler fuels. This is at present of minor importance to Germany as compared with the fact that her surplus coke supplies can be used—staving off the possibility of a fuel famine, and permitting full military advantage to be taken of the by-products of coke manufacture.

REVIEWS.

The Mathematical Analysis of Electrical and Optical Wave-motion on the Basis of Maxwell's Equations. By Dr. H. Bateman. Cambridge: University Press. Price 7s. 6d. net.

The author intends this book to be an introduction to some recent developments of Maxwell's electromagnetic theory which are directly connected with the solution of the partial differential equations of wave-motion. A complete investigation of the subject requires very great mathematical knowledge, and the author does not aim at supplying proofs which depend upon difficult and complicated analysis, but, rather, at simply stating such proofs and dealing in detail with those portions of the subject which do not require such advanced mathematical treatment. The principle of relativity, which has been recently treated by several authors, has not been dealt with, and details of numerical computation are omitted.

Perhaps to the physicist and electrician the most interesting portion of the work is that dealing with the structure of the aether. It is shown towards the end of the book that mathematical analysis indicates three distinct theories of the universe, which may be described briefly as follows: —

	Aether.	Matter.
(1)	Continuous medium.	Aggregates of discrete particles.
(2)	Discontinuous medium, consisting of a collection of tubes or filaments.	An aggregate of discrete particles attached to the tubes.
(3)	Continuous medium.	An aggregate of discrete particles to which tubes are attached.

The first theory is, of course, that which has in the past received most attention, and is the one which is most satisfactory from an experimental point of view, and the mathematical study of theories (2) and (3) may possibly help to enrich it.

Some of the subjects treated of are (1) a general survey of the different methods of solving the wave-equation, (2) polar co-ordinates, (3) cylindrical co-ordinates, (4) the problem of diffraction, (5) homogeneous solutions of the wave-equation, (6) electromagnetic fields with moving singularities, (7) miscellaneous theories.

For the practical man the work is much too mathematical, but for the student of pure science it is a most useful addition to the literature of the subject. It remains to be added that much of the work is original and due to the author himself.

Tramway Track Construction and Maintenance. By R. Bickerstaffe Holt, M.I.M.E., etc. London: *Tramway and Railway World* Offices. Price 10s. 6d.

Despite the large amount of tramway construction which has been executed during the last 20 years, there is very little literature setting out how such work should be done, what to avoid, what to insist upon, and how to secure a permanently satisfactory job. Tramway track construction is in many respects special and peculiar; the necessity for conforming to street alignment and levels, the condition that it must be paved over, and that the track paving must bond into that of the rest of the street, and other limitations which will occur to any tramway engineer, differentiate it widely from, *e.g.*, railway track construction. There is, therefore, ample room and justification for a book which describes

methods which have been found satisfactory and gives a reasoned consecutive account of the work, including the important question of maintenance.

Mr. Holt's book partly fills this room. The author is permanent way engineer to the Leeds Tramways, and, as such, has been responsible for the construction and maintenance of a large tramway system for many years—time enough to find out what happens to tracks in use under conditions of subsoil, surroundings and traffic of considerable diversity; and he has recorded the results of his experience with clearness, sincerity, and a fullness of reasons for his practice and advice that is somewhat rare in technical books of this kind, and will be found refreshing and convincing by his readers. Convincing, that is, in the sense that the reason behind the views expressed is always in evidence.

The first chapter is headed "Concrete Foundations," but is mainly occupied with defective concrete work, as revealed in the course of maintenance and reconstruction, with some discursive remarks on wrong methods of laying and abortive methods of repair. The belief that concrete foundations are good for all time will be dispelled, it is said, in the majority of cases when reconstruction becomes necessary. Mr. Holt rightly insists that fractured concrete is generally due to original defects in construction, and that there is nothing to do but cut it out and replace it.

Chapter II deals with concrete materials. Stress is properly laid upon the selection of hard stone broken to angular shape (it might be added, and to fairly regular size, not exceeding what will pass a 2-in. screen), and of clean sharp sand.

Two novelties are mentioned as having given satisfactory results at Leeds—clinker sand from the local refuse destructors, and "trass," or ground puzzolana, which is claimed to give some elasticity to the concrete, to cause it to set from the centre, and to harden to greater strength. A concrete of 7 stone, 1 trass, 2 sand, and 1 cement is stated to be equal in strength to ordinary 4-2-1 concretes. This deserves serious attention. The use of puzzolana is not *per se* a novelty, as it was used by the Romans in their best lime mortar, which has endured for many centuries in well-known examples, a good omen for the Leeds tracks.

Chapter III deals with repairs to concrete foundations. It ascribes most of the trouble with loose rails and paving to fractured concrete, in the main to longitudinal fractures under one or both rails, and advocates the cutting out of fractured foundations, replacing the old concrete with a foot of new made with quick-setting cement, and the observance of precautions to keep the traffic weight off the new concrete until it has set.

Chapter IV, entitled "Track Design," commences with the statement that "British permanent way cannot be said to have been too well designed." It has, in fact, been too much stereotyped, with little regard to the peculiar requirements of each locality, and, in consequence, methods of construction which have been satisfactory in one district have failed in others. The subsoil, the weight and density of the vehicular traffic, the speed and weight of the cars to be run, and the frequency of the service, Mr. Holt points out, should all be considered. He might have added that financial considerations should be duly weighed, and if he had been writing as a tramway company engineer doubtless this aspect of track design would have been given more weight. The most difficult conditions are set by a sandy subsoil subject to alternate heavy rain and drought, where the road bottoming is but a thin crust, entirely cut through by the excavation for the track. These conditions result in irregular subsidences, and either concrete stringers or a complete concrete raft the whole width of the track and margins will fail by transverse fracture. Sleeper construction with hard packing of broken stone under the sleepers becomes the most economical form of substructure. In mining districts, heavy longitudinal sleepers under each rail have proved satisfactory; in sandy subsoil cross sleepers are better. The importance of subsoil conditions is well exemplified by comparison of constructions found successful at The Hague, where the rails are laid directly upon a firm sandy soil, and Amsterdam, where, owing to water-logging, the same method failed, and had to be replaced by concrete foundations.

Chapter V, on rail packing, is a detailed account of the methods and materials used by the author. The importance of this operation and the care necessary to ensure its success in giving the rail bases uniform support and contact justify the amount of detail.

Chapter VI deals with rail laying; the procedure described is thoroughly sound, the pitfalls of inexperience are pointed out, and the reasons for the right, and against the wrong, methods clearly set out. The somewhat controversial question of anchoring is discussed in some detail, mainly as to the proper means of securing the advantages of anchors.

Chapters VII and VIII deal with joints, and are to be unreservedly commended. The second is confined to joint welding, describing both Thermit and arc welding, and their application to both construction and repair work. Mr. Holt has had good results from both, and most experience with Thermit, but is not prepared to admit their superiority to well-made plated joints. It does not appear that the desirability of joints being neither more nor less rigid vertically than the rails themselves has met with the consideration it deserves from tramway engineers generally, and it is not specifically set out by the author.

Chapter IX, on "Wear of Rails," is mainly a statement of facts observed and how wear may be minimised, and is well worthy of careful study. The same remarks apply to Chapters X and XI, on "Composition, etc., of Tramway Rails" and "Rail Corrosion." It will cause some surprise that corrugation is but slightly mentioned, and that no theory of its causes is put forward.

"Track Paving" is dealt with in Chapter XII with much thoroughness, the correct and incorrect methods of sett-laying being fully described. Mr. Holt has found soft wood paving last as well as hard wood on tramway tracks, and thinks that wood paving does not altogether deserve the bad name it has among tramway men. The trouble due to rutting alongside of the rails is not even mentioned, although an illustration of soft wood paving after ten years' service shows this distinctly.

Chapters XIII and XIV, on "Reconstruction" and "Rail Drainage, Cleaning and Grinding," describe up-to-date practice. The Woods-Gilbert rail planer is described and illustrated. The use of this machine seems well worth attention, and may give worn rails a new lease of life.

"Special Trackwork," dealt with in Chapter XV, is likely to provoke some difference of opinion. The author strongly deprecates the existing lack of uniformity in design and layout, to which he attributes excessive cost and the need for stocking large numbers of spares. There should be an effort made to standardise these important materials, and clearly much more might be done in that way than has been attempted. As regards renewable inserts, the author has not found the expected benefit. Wear occurs which prevents the new inserts joining up with the old surfaces. Hence, he prefers solid manganese steel special work. The difficulty of drilling this material is not mentioned.

Appendix A on "Special Track Construction," by Mr. Ernest Lamwith, is a useful addition, the author having selected and developed methods at once simple and suitable for tramway conditions. It may be noted with regret that nothing is said either in the Appendix or any part of the book as to the best methods of transferring the calculated and plotted track positions to the street surface, a matter of no little importance.

In conclusion, one may say that whilst this book is a valuable and very fairly complete exposition of tramway track construction in town streets, it does not deal with the important differences that occur in work on country roads, or unformed roads and cross-country work where mixtures of tramway and light railway methods apply, and where capital economy is of paramount importance. This is no discredit to the author, who has confined himself to the conditions of his own experience, but indicates that a text-book on construction in different conditions is still needed.

Overhead Transmission Lines. By F. Kapper. Translated by P. R. Friedlaender. London: Constable & Co. Price 16s. net.

Naturally this book deals primarily with German regulations and German equipment and practice. The translator has incorporated Board of Trade rules relating to overhead transmission lines, and has used English weights and measures. We believe, however, that all the examples of pole or tower construction are from German practice, and that practically all accessories illustrated (insulators, connectors and so forth) are of German make; such prices as are included appear to be based on German markets for labour and material, and German symbols are used in such formulæ as are included. Occasional reference is made to American practice. It is a pity that English practice and material could not have been incorporated—if not actually substituted for some of the Teutonic matter—but this difficulty always arises in translating any technical work designed originally to meet the requirements of a particular country. As it is made very clear which rules and which apparatus are German, any misgiving based on prejudice or expectancy of confusion should be set at rest.

The main object of the book is to explain fundamental principles, and give data essential to the proper execution of the varied duties falling to the lot of the engineer engaged in modern overhead line construction and maintenance. This aim is very well fulfilled. Numerous worked examples, mostly from practice, are included to supplement the text and illustrate the application of formulæ. The scope of calculations seems to be carried far enough to cover the direct practical requirements of designer and constructor, and no further. The whole work may, therefore, be read with profit by the average student or older engineer interested in this branch of engineering. The author writes from the mechanical standpoint, and no information is included concerning electrical design, pressure surges, corona, etc.

The physical properties of conductor materials are first dealt with, and the relative merits of copper and aluminium neatly compared. Sag and tension relationships are then treated by simple mathematics, and a number of tables, curves and examples are included. The next section, on the design of supporting structures, is necessarily almost entirely mathematical, but the working is made quite clear, and the reader's path is smoothed by systematic arrangement of the various cases considered (single pole, stayed pole, double pole, etc.) and by the inclusion of numerous examples. Lattice pole calculations here and elsewhere in the book might be arranged rather more clearly, and paragraph and section headings, particularly in

Chapter 4, might be thrown into clearer relief. Stability problems and forces set up in foundation blocks are treated analytically in Chapters 5 and 6, and practical notes on means and methods of foundation construction and pole-fixing are given in the next two sections. Pole construction is discussed in a long, well illustrated section, but the notes included on impregnation of timber poles might profitably be extended and made more critical in nature; less than justice seems to be done to creosoting processes, which British experience has proved so satisfactory.

The treatment given to insulators is useful (though by no means comprehensive), and is followed by practical sections on insulator mounting, wire attachment, and joint and branch connections. The chapter on arrangement of wires should certainly be extended, and we believe that some attention might be given to inductance, capacity, and voltage drop calculations. Practical notes on earthing methods and devices are included, and a long chapter deals with crossings over postal wires, railways and roads; after describing and illustrating the general arrangement adopted, the author presents detailed calculations and schedules. The actual erection of poles or masts and wire forms the subject matter of two interesting sections, which are followed by one summarising rules and hints for the design and erection of overhead lines.

An unusual feature and one of great value is the inclusion of sections dealing with instruments for surveying and laying out the route of a line, and with the actual procedure of surveying and entering up the necessary observations. Typical field record sheets are presented, and useful notes and suggestions are made in connection with the erection of poles on private property. A series of curves is included showing the influence of span on cost of construction, and it is pointed out that a span longer than that which is theoretically most economical is often justified. A corresponding section compares various supporting structures with reference to minimum annual charges and on the basis of different spans. The long chapter on local overhead distributing systems should prove very useful if considered in conjunction with English conditions and regulations. The final sections include a model form for agreements with contractors, a schedule of prices, list of tools and appliances; and B.O.T. and V.D.E. regulations relating to overhead transmission schemes.

Taken as a whole this book is excellent, and its production is beyond criticism, except that it is distinctly extravagant of space, and a reduction in price, effected by economy in this respect, would be very welcome in later editions.—R.E.N.

SOME DIFFICULTIES OF DESIGN OF HIGH-SPEED GENERATORS.

In the course of the discussion at Leeds on the paper read before the Institution of Electrical Engineers by Prof. A. B. Field, reported in our issue of December 17th, Mr. S. F. Barclay, of Messrs. Vickers, Ltd., made an exceptionally interesting contribution to the discussion, which we are pleased to be able now to print *in extenso*:—

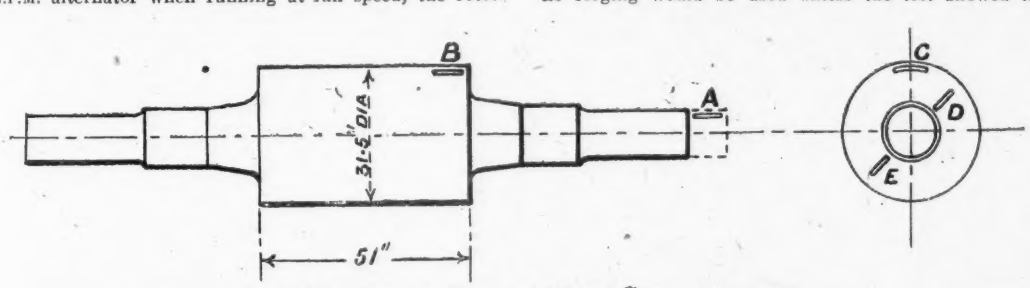
With regard to the steel rings for retaining the rotor end windings, there is one point to which the author has not referred, and that is the opening of the rings due to centrifugal force. For example, in the case of a typical 5,000-kw. 3,000-r.p.m. alternator when running at full speed, the rotor ring increases 0.03 in. in diameter, and is therefore actually floating quite clear of its seatings. It is not practicable to prevent the floating by shrinking the rings on to their seatings. The floating may have several undesirable effects, but the principal one is change of balance. This undesirable feature is entirely safeguarded against by making the ring and its outer supporting flange all in one piece. This construction is adopted by Messrs. Vickers, Ltd., as standard with all sizes of polyphase turbo-alternators. In the case of single-phase machines, a similar construction is employed, but a band of high tensile manganese-bronze is introduced between the core and the steel ring. The extra cost of the solid steel end ring compared with the built-up construction is justified by the mechanical soundness gained, and the construction also has other useful features. For example, the supporting flange can be given such stiffness that the ring does not need to be registered on the core; an effective gap between the core and the ring may thus be provided, very considerably reducing the magnetic leakage. Moreover, the opening between the ring and the core is most effective in improving the ventilation of the rotor end windings. The short length of rotor coil between the core and the ring is given adequate support by extending the wedges beyond the core into the ring. The ring is made a sound press fit on its seating on the shaft, and is positively driven by keys of ample size. The complete ring is turned from a hollow nickel-chrome steel forging having an elastic limit of at least 40 tons to the square inch, an ultimate strength of at least 50 tons to the square inch, and a minimum elongation of 20 per cent. After being forged the rings are annealed, and after rough-turning are re-annealed, oil-hardened and tempered. The treatment ensures the rings being homogeneous throughout and free from appreciable initial stress. Circumferential and longitudinal tests are taken from each ring.

Under any ordinary condition of out-of-balance—such as occurs in furnace work, etc.—the solid steel end rings are found to keep perfectly cool. The amount of out-of-balance for which the machines described by the author had to be designed is quite unusual, and no doubt it was desirable to introduce a little copper into the rings in the way described.

The wedge described by the author is ingenious, but in my experience is unnecessary. If a good lead is given to the wedge and a metal liner is placed on the top of the coil, all the downward pressure desired can be obtained with an ordinary wedge. Moreover, the wedge described must require special tackle to apply the vertical pressure to the whole of its length, and that might be a grave disadvantage in carrying out a repair on site.

As the rotor revolves, the stress in the bolts increases as they move to the bottom and decreases as they move to the top. Therefore, superimposed on the constant initial stress is an intermittent stress being applied and removed over 2½ million times a day. Since the bolts are a reamered fit in the core, the diameter of the screwed portion must be less than that of the body of the bolt. Therefore, the area of the bolt in the short length between the face of the nut and where the thread ends is appreciably less than that of the rest of the bolt. As the intermittent stress comes on, the short length of reduced area stretches more in proportion than the body of the bolt, causing local weakness. Also, the driving torque by tending to twist the rotor and increase the bolt length adds to the bolt stress, and a short-circuit must similarly add considerably to the stress. It is also to be remembered that the action of tightening the nuts must impose a considerable torsional stress on the bolts. It is, therefore, to be expected that a breakdown will occur in the course of time in consequence of a fatigue fracture at the bottom of the thread just outside the nut. It would be interesting to learn how long the machines have been running, and if there have been any failures. The construction could have been improved by using high-tensile steel bushes, a reamered fit through the core, and with the bolts passing through them with an ample clearance, and turned down their whole length to a diameter slightly less than the diameter of the bottom of the thread.

The statement made by the author at the discussion in London that steel manufacturers would not accept the test in a radial direction immediately below the surface must be contradicted. The maximum stress in the rotor occurs at the root of the tooth, and from every forging made by Messrs. Vickers, Ltd., a radial test is made at that part, and no forging would be used unless the test showed that the properties of the steel were in every respect suitable for the duty. An example of the results obtained in the case of a rotor forging for a 5,000-kw. 2,400-r.p.m. turbo-alternator is given herewith:—



Rotor Forging for Vickers 5,000-kw. Turbo-alternator.

Test.	Description.	Elastic limit.	Breaking.	Elongation per cent. on 2 in.
A	**Longitudinal**	19·5	36·0	34·0
B	**Longitudinal**	20·5	36·0	32·0
C	**Tangential**	22·0	37	28·0
D	**Radial**	20	36·8	14·5
E	**Radial**	19·5	36·4	15·0

It will be noticed that the tensile strength is practically uniform throughout, and the elongation—even in the case of the radial tests—has a very satisfactory value.

It is always possible to work to a factor of safety of at least 6 to 1, and when it is remembered that the tooth stress

is a pure tension and constant in magnitude it shows how safe is the forged rotor construction. Provided that high-class forgings can be obtained, undoubtedly the solid forging is the ideal construction for all outputs at 3,600 and 3,000 R.P.M. For large outputs at 1,500 and 1,800 R.P.M. the soundest construction is to have a hollow forged cylinder shrunk on to a through shaft. With either construction a definite guarantee can be given for the strength of the steel in the direction required.

The only possible apology for the rotor built-up of plates bolted together is that the construction saves money.

In dealing with solid forged steel rotors there are several essential points that must be observed:—

1. Large allowances must be made on the forging, so that all metal unavoidably damaged by the forging process is removed by machining.

2. By a thorough annealing after the forging has been made, and by re-annealing, oil-hardening and tempering after the forging has been rough-turned, the forging must be rendered homogeneous and free from appreciable initial stress.

3. The rotor design must be such that at all parts the rate of change of stress is gradual and within the capacity of the steel. The average stress at any point may be quite low, but due to a too abrupt change of section the rate of change of stress may be too great, resulting in the crystals sliding over one another, and so causing a fatigue fracture to develop. Not only must the shaft between the journals and the core be carefully stepped, but also large radii must be provided at all changes of section, and, moreover, all the radii should be formed truly and be given a dead-smooth finish.

An additional point in favour of the forged steel rotor that will be appreciated by the purchaser is that in the remote contingency of there being any flaw not detected by the tests and exposed by the machining operations, it is almost certain that the overspeed test at the makers' works would show its presence, whereas with a rotor of the kind described in the paper, any defects of design would most probably not be found out until the machine had been in service for some time.

I can quite appreciate the statement made at the top of page 5, that the type of rotor described has no true critical speed, but the explanation given by the author is not clear. The area of the plates in compression is very considerable compared with the area of the bolts, and, therefore, the addition of even a few hundred pounds to the bolt stress would cause the bolts to elongate sufficiently for the plates to lose their compression and become loose. This opening and closing of the plates would effectively damp the natural transverse vibrations, and, therefore, the rotor would have no critical speed. This condition holds good if the fit of the spigots is free, but if they were made of a good press fit one inside the other very probably there would be a definite critical speed having a value liable to change and difficult to forecast.

ELECTRICAL FITTINGS ON LEASEHOLD PREMISES.

[From a Legal Contributor.]

There are certain factors in the present situation which appear to make it desirable to consider once again the legal position of landlord and tenant in relation to electric fittings. The unwelcome visit of a Zeppelin to the "London district" may result in the destruction of a large quantity of electrical property; and it may become necessary to consider who is to bear the loss. It is a well-known maxim of the law that *res perit domino*.

Another consideration makes it desirable to refer to the law of landlord and tenant. Owing to the economic condition brought about by the war, a large number of leases now current will not be renewed at the same rent. Possibly they will not be renewed at all. In these circumstances, what is to become of the electrical fittings?

Questions have frequently arisen in the past as between landlord and tenant as to the ownership of electric light fittings. A tenant who incurs the expense of fitting out a house with a complete electrical installation is not unnaturally astonished to find that, at the end of the lease, the landlord asserts his rights as owner of the soil by saying that whatever is annexed to the house or building must, of necessity, become his property. In so doing, the landlord relies on the ancient maxim *quiquid plantatur solo, solo cedit*.

Before proceeding to consider particular cases, it may be well to understand the general principles of law by which fixtures become vested in a landlord. The consideration whether the article is essential to the enjoyment of the premises on the one hand, or whether it is a mere convenience on the other, is a material element in deciding the character of the annexation as being complete or incomplete respectively. There are, however, certain articles which are removable as between landlord and tenant, which have so become removable by custom, having regard to the reason of the *purpose* for which such annexation was made. Amongst these are certain articles of trade, agriculture, ornament, and convenience.

In all cases, of course, where fixtures are taken down, it appears that the tenant is liable to repair the injury the premises may sustain by the act of removal. The fact that an article can be removed in its entire state is an element to be considered in drawing the conclusion that it is removable.

Amongst fixtures for domestic use or ordinary convenience which have been held to be removable by the tenant are cupboards fixed with holdfasts, clock cases, bells, and gas fittings.

Applying the foregoing principles, it will be seen that electric fittings, though *prima facie* some of them may be fixtures, must to a certain extent be treated as removable. Roughly speaking, the line appears to be drawn in practice between those parts of an installation which are necessarily of a permanent character and those parts which may be altered to suit the fancy of a particular tenant. Regard must also be paid to the extent to which any particular article is affixed to the freehold. It is obvious, for instance, that wires embedded in the plaster of a wall could not by any stretch of the imagination be regarded as a fixture which a tenant was entitled to remove. It would be as fair to say that a gas pipe put in by a tenant as part of a lighting system did not become the property of a tenant. On the other hand—to go to the other extreme—it is clear that a mere incandescent lamp could not possibly be looked upon as the property of the landlord.

It is somewhat remarkable that the only case which throws any clear light on the subject is one in which it was held that gas fittings do not vest in the landlord. There appears to be no reported decision on the subject of electric fittings, and questions relating to them must be answered by having recourse to first principles.

It is now proposed to deal with concrete cases.

(*a*) A tenant *wires* a house which he holds under a lease for years. Do the wires vest in the landlord at the end of the term?

It is clear that in this case the wires and the casing of the wires vest in the landlord, and cannot be removed by the tenant unless pursuant to special powers conferred upon him by his lease. A tenant would be liable if he attempted to remove the wires.

(*b*) A landlord *wires* a new house, and the tenant puts in switches, distribution boards, and lamp brackets. Can he remove them at the end of his tenancy?

With regard to switches and distribution boards, these appear to fall within the category of articles which are of a permanent character, and would have to be used in practically the same form in relation to any installation. At any rate, one would be sorry to advise a tenant to remove them only to leave blank spaces on the walls to which they were affixed.

With regard to lamp brackets, these appear to fall within a different category. They are often fanciful in design and very expensive. They can be removed without doing damage, often by the mere turn of a screw. In these circumstances, it appears to be clear that they are tenant's property which he can remove at will.

(*c*) A tenant puts in a transformer at his own cost and expense. Does the transformer vest in the landlord?

With regard to a transformer, this appears to be a separate instrument which would clearly be easily detached, and must be treated as a tenant's fixture which he can remove.

(*d*) A tenant puts in ceiling roses, made of metal or porcelain, and wall plugs. Do any of them belong to the landlord?

Ceiling roses appear to be very much on the border line, but it would seem that, inasmuch as they are generally ornamental objects, they should be treated as tenant's fixtures. It is probable that, in case of a dispute, a reasonable landlord would agree to treat an ornamental rose as the property of his tenant and the ordinary white roses as landlord's fixtures. As to a wall socket, *i.e.*, the part into which the plug is fitted, it is conceived that this would be a tenant's fixture, as it might easily be removed and replaced by a permanent connection to a wall or bracket lamp.

(*e*) Assuming a tenant installs electric light throughout a house, can any action be brought against him by his landlord if, on finding that the landlord refuses to pay anything towards it, he deliberately cuts or damages the wires without defacing the decorations?

It is clear that if a tenant does any damage, whether by removing landlord's fixtures or improperly removing his own, he can be held liable to make it good.

The ordinary covenant to repair and leave in repair would clearly impose such a liability upon him.

With regard to damage done by fire, the question as to who is liable depends upon the ownership of the fittings. As a rule, leasehold premises are insured against fire in the name of the landlord, the tenant paying the premium under covenant to that effect inserted in the lease. In these circumstances, in so far as the electric fittings were or had become annexed to the freehold, they would be covered by the landlord's policy. As to fittings which are obviously the tenant's, they would be covered by the policy which a prudent tenant takes out for the separate protection of his own furniture and effects.

War risk insurance is a matter which the tenant should take into special consideration, because it is *not* covered by an ordinary fire policy. If an incendiary bomb, thrown from a Zeppelin, causes a fire to break out, the tenant must (if his is an ordinary repairing lease) reinstate the entire building.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Institution and Alien Enemy Members.

This subject has been discussed for several weeks in your "Correspondence" columns—unfortunately anonymously—and the Council of the Institution now informs the members that it is helpless in the matter, because it is advised that it has no power except under Article 41. Is the Council unaware of the existence of Article 80 (1912 ed.), which is drafted with special reference to altering or adding to the Articles of Association? Why, then, not draft and pass a suitable new Article for the purpose of effecting what appears to be the general desire of the members? There would be little difficulty in drafting such an Article.

In "ordinary times" it has always been my pleasure to passively support any proposal put forward by the Council, but these are not "ordinary times," and those members who are not indifferent to patriotism must take active steps to secure a new Article to deal with the new conditions now prevailing. If there be honour, if there be benefits, if there be privileges in belonging to the Institution, founded 44 years ago, as the Council has told us it is helpless, it is for the members to say whether the enemy aliens are to enjoy those honours, etc. I, for one, am prepared to say most emphatically no, they shall not, because I firmly believe that the credit of the Institution in years to come must be enhanced by expunging at the present time any representatives of a nation which has sunk beneath the cognisance of civilisation, and that 50 years hence the members who then form the Institution will feel proud of the attitude adopted in 1916 if we now decline to admit any association with enemy aliens. Such scraps of paper as Article 41 may well be superseded.

Chas. A. Baker.

Victoria Embankment, W.C.,
December 28th, 1915.

[We reprinted the Council's statement and Article 41 in our last issue. We may point out (1) that the Council never said it was helpless, (2) that Article 41 contains adequate powers for the purpose aimed at by our correspondent, if the Council chooses to exercise them, and (3) that the reason why the Council did not say so is a matter for conjecture.—EDS. ELEC. REV.]

WAR ITEMS.

The Waste of Brains.—The Conference of Headmasters was held at the Board of Education last week, and among the resolutions adopted, says the "Times," was one which called attention to the unwisdom of employing young students of mathematical and scientific ability as subalterns in Line battalions. It was pointed out that the place for the man of action was at the front; that for the young man who had a special gift for science, mathematics, or mechanics was in the laboratory. This was eminently a war of science, and the mathematical and scientific ability of the country should be husbanded jealously. It might be said that with the end of the war the need for such men would be less pressing, but the fact was that the present warfare in the field would be child's play to the grim commercial struggle which the Germans, with a far-sighted concentration of purpose compelling our admiration, were already organising. The resolution was carried unanimously.

Callenders at the Front.—We have received a copy of the December issue of "Callender's Staff Service Gazette." It contains a very lengthy Roll of Honour of men from the London office, the Belvedere Works, the Anchor Works, and outside employés of Callender's Cable, etc., Co., who are with the Forces. Extracts are given from a large number of letters that have been received from them. Inset is a life-like portrait of "Mr. Tom (our managing director)," and one of 2nd Lieut. T. O. Callender, R.M.L.I.

Exports to Switzerland.—The "London Gazette" for December 24th contains a lengthy list of articles that may not be exported to Switzerland unless consigned to the Société Suisse de Surveillance Economique. The list includes electric accumulators and accumulator plates, electrical fire-lighters, electrical carbons, electrical insulated wires and cables, electrodes, piles and component parts, electrical machinery, dynamos and motors, magnetos, mica (rough and worked), materials for telegraphs, etc.

War-Workers' Theatre.—The Vickers Company have built a modern and most attractive Picture and Variety Theatre (of which we have received some illustrations in colour) in the neighbourhood of one of their very large works, with the object of providing relaxation and recreation for their war-workers.

After the War Trade.—In the House of Commons last week Mr. Runciman, President of the Board of Trade, made a long and interesting statement respecting the after the war trade investigation work that had been occupying the attention of the Board in conjunction with outside industrial experts for some time past. Unfortunately pressure upon our space compels us to hold over fuller reference to the matter until next week. The Board has been doing a vast amount of work which it is politic to perform in secret, but the statement that Germany is a commercially beaten nation, while it is perfectly correct in regard to the effects of the blockade by our Fleet during war-time, will not be true when the blockade be raised unless all the information collected enables us to adopt a strong national and allied trade policy. Much is expected from the conferences that are to take place between ourselves, the Colonies, and the Allies. The Allied Trade Conference in Paris was to have taken place in January, but we read in the "Times" of Wednesday that it will be held in March, that it will be attended by the High Commissioners of the Dominions, and that among the subjects to be discussed will be the commercial relations with the belligerents during the war, protection against German commercial invasion after the war, the establishment of an International Patent Office, and an allied preferential tariff applicable to the Colonies.

Tasmania and Enemy Contracts.—The Attorney-General (Mr. Earle) of Tasmania has introduced a Bill to provide for the cancellation of enemy contracts. It provides for the annulment of all contracts to which an enemy subject is a party or in which he has a material interest, or which are likely to be for the benefit of enemy subjects or of enemy trade. Power is also given to terminate contracts suspended by the war.—"Tenders."

LEGAL.

OSRAM LAMP WORKS, LTD., *v.* POPE'S ELECTRIC LAMP CO., LTD.—JUDGMENT.

(*Concluded from page* 807.)

IT was said for the applicants that the differences were differences in degree only; that was not his view of them. In his opinion they passed the border line which separated a difference in degree from a difference in kind, and the defendants' process, as a whole, was, in his opinion, substantially different from the one described in the plaintiffs' specification. If the test to be applied was the commercial value of the result there could be no question on this point, as the one process enabled the filaments to be made in bulk, whereas the other required each individual filament to be separately handled before the electric current could be passed through it. The applicants, however, contended that though the defendants' process might to the eye appear different, and might contain various improvements, yet the defendants had taken the substance of their invention, and applied it to the manufacture of their filaments. The way in which the case was put was this:—It was said that the real principle or substance of the invention was the application of the known reaction between steam and carbon to get rid of any carbon in the filament while leaving the tungsten metal unaffected. It was said that the use by the defendants of tungsten oxide in their mixture rendered it impossible for them to carry out their process without making use of the steam-carbon reaction, because when the filaments reached the required degree of heat steam was produced, either from the small quantity of water contained in the material of the filament or from the oxygen in the tungsten oxide combining with the hydrogen introduced into the furnace, and this steam reacted with the carbon in the filament and dispersed it. A number of experiments were given in evidence with the view of proving this, and the two main points endeavoured to be established were:—(1) That the reaction between oxygen and carbon, which the defendants claimed to be the agent by which they expelled the carbon from the filament, did not take place below a temperature variously given at 1,000 to 1,030° C.; (2) that much below that temperature the carbon was found in the defendants' process to be in course of being expelled, or, in other words, that before a temperature was reached at which the oxygen-carbon reaction could take place, the filaments had passed through a temperature at which the steam-carbon reaction must have taken place.

In his opinion it was not enough for the plaintiffs, in the peculiar circumstances of this case, to say this. It was not disputed that the oxygen-carbon reaction would, at the appropriate temperature, disperse any carbon in the filaments, and the question, therefore, must be not only whether the filaments had passed through the range of temperature appropriate to produce the steam-carbon reaction, but whether that reaction had to any appreciable extent dispersed any of the carbon in the filaments. To do so to a merely negligible extent could not, in his opinion, constitute an infringement of the plaintiffs' patent. On this question the time during which the filaments were in course of passing through the material range of temperature appeared to him to be important, but he could find no evidence directed to that point.

The material facts on this question appeared to him to be as follows: The defendants' mixture, or paste, after calendering, contained about 12 per cent. of carbonaceous material. This was reduced by the first ovening process to 2 per cent., and it was in this condition that the filaments were introduced into the first

furnace in which the infringement was alleged to take place. When first taken out of the furnace the filaments contained 0·2 per cent. of carbon. The difference between these two quantities had, therefore, been dispersed during the 30 minutes, or thereabouts, during which the filaments had been in the furnace. By what agency had this been done? The first material point to establish in this connection appeared to him to be the temperature at which the steam-carbon reaction commenced to operate, because nothing which occurred in the furnace below this temperature could amount to a taking of the plaintiffs' invention.

On this point he found a great want of certainty in the evidence. At first the temperature was stated to be 600° C.; then it rose to 700° C., and later still to 800°. In order to ascertain what was going on in the furnace, the plaintiffs made an experiment, in which they interrupted the process at 500° C. Why this interruption took place at this stage was not explained, except that it was a sort of half-way house. It was ascertained that at that stage of the process the filaments contained 0·6 per cent. of carbon, that was to say, that the difference between 2 per cent. and 0·6 per cent. had by that time been dispersed by some agency which could not be any infringement of the plaintiffs' patent. What occurred in the furnace during the time that the filaments were travelling from the point at which the temperature was 500° C., to the point, be it 700°, or 750°, or 800° at which the steam-carbon reaction commenced, there was no evidence to show, and it was quite consistent with the evidence that the carbon had been reduced from 0·6 to 0·2 before the filament reached that point. No evidence was given as to the time occupied by the filaments in passing through the material range of temperature. In his opinion, so far as the plaintiffs' evidence on this point was concerned, it fell short of proof, and, so far as this experiment, and others intended to support it, were concerned, they had failed to satisfy him that any carbon in the defendants' filaments was to any appreciable extent dispersed by the steam-carbon reaction.

What he had just said with regard to the first furnacing in the defendants' process applied with equal or greater force to the second furnacing, where the filaments were passed rapidly up into a temperature of over 1,000°. Dr. Passmore apparently did not regard the plaintiffs' case as very hopeful on this point, as he said, when dealing with it, that the steam and hydrogen acting in the filaments might have removed all the carbon before the other (that is, the oxygen-carbon reaction) had a chance of taking place.

The conclusion at which he had arrived as to the first furnacing applied also to the vacuum process, where the alleged infringement was said to take place by the accidental presence of water vapour, which the defendants could not prevent, and which was said to be the agent which released the necessary hydrogen to form the steam and hydrogen atmosphere which constituted the alleged infringement.

He passed now to consider the other point mainly relied upon by the plaintiffs, namely, that the oxygen-carbon reaction could not take place at a temperature below 1,000° C. It was confidently asserted in argument that this was so, and the various experiments given in evidence were gone through in detail in support of the statement, as well as the evidence given by the plaintiffs' expert witnesses. These experiments were elaborately criticised by Mr. Terrell, who referred also to the opinion of the defendants' expert witnesses on the point.

He had carefully considered the evidence and arguments of counsel, and, as a result, he was not convinced that in the defendants' process, as carried out, the oxygen-carbon reaction did not commence at a temperature lower than 950° C.

The general conclusion, therefore, at which he had arrived was that the plaintiffs had failed to establish their case from whichever point of view it was to be regarded, and the appeal, therefore, failed, and must be dismissed, with costs.

Lord Justice Warrington also delivered a judgment dismissing the appeal, in the course of which he said there were in the defendants' process two chemical factors tending to produce the desired result. The evidence was insufficient to determine the precise part played by each, and he thought the Court was justified in holding, under those circumstances, that the plaintiffs had not proved that the carbon was removed substantially as described in the specification. But if he was wrong about that, he should still be of opinion that the defendants' process, taken as a whole, did not infringe the substance of the plaintiffs' invention, as described in the specification. It started from a different standpoint. The several steps in it were different in nature, and had different aims and results, and these variations were not merely colourable alterations. The result was that, in his opinion, the appeal ought to be dismissed.

Lord Justice Bankes said the Master of the Rolls (who was absent from indisposition) desired him to say that he concurred in the judgment delivered by Lord Justice Warrington and himself.

Mr. Walter: My Lord, this is a very important matter. The taxation of the costs in the Court below was allowed to stand over until after the hearing in the Court below. I do not know whether my friend would agree to the taxation standing over until after the final hearing?

Mr. Terrell said he could not agree to anything.

Mr. Walter: Your Lordship, I suppose, would not grant a stay?

Lord Justice Bankes: No.

Bradford County Court Case.

"S. Roberts Bros. and Holloway, Ltd., electrical engineers, Bradford, were the claimants in an action heard at the Bradford unty Court last week before his Honour Judge Graham, K.C., against Messrs. Brown, Vickers & Co., manufacturers, of Bradford, for £72 for work done. The defendants had paid £45 into Court. Mr. Newell, for claimants, said that his clients had accepted a contract from the defendant company to perform certain work at their premises for £25, and, afterwards, certain "extras" had been added. Mr. Watson, for defendants, said that all it was necessary to decide was what sum was due from the defendants to the plaintiffs for the work which had been performed, and whether or not the sum of £72 was excessive.

After argument, arbitration was suggested, and ultimately it was agreed by both sides to refer the matters in dispute to Mr. Felshaw, of Harrogate.

Albion Electrical Co., Ltd., *v.* L.K.W. Syndicate, Ltd.

At the Lambeth County Court on December 21st. before Judge Parry, the Albion Electrical Co., Ltd., of 67, New Oxford Street, W.C., brought an action against the L.K.W. Syndicate, Ltd., of 31, Great St. Helen's, E.C., to recover £58 19s. 8d., balance of account for overhauling the electrical installation at the Brixton Hall, now known as the Khaki Hall, Brixton, and so altering it as to comply with the requirements of the London County Council.

Mr. H. G. Simmons, for plaintiffs, said that on July 26th Mr. Charles Lille, manager for the plaintiffs, was approached by a Mr. James P. Naylor, an electrical engineer, to carry out certain electrical alterations to the fittings at the hall, then known as the Brixton Hall. He saw a Mr. Thomas Harold Crosby, who was the secretary of the L.K.W. Syndicate, and, as time was short, no estimate was prepared, Mr. Lille agreeing to carry out the work on the basis of being allowed 20 per cent. on the cost of material, 50 per cent. on the cost of labour, and engineers' fees. The work was a push job, but was completed, the hall being opened on July 27th. He had great difficulty in obtaining payment, but eventually received a cheque for £5, signed by Crosby as secretary and manager of the L.K.W. Syndicate. He still pressed for payment, until he received a letter from Crosby on October 1st, stating that he was not to hold the syndicate liable for the account, but was to look for payment to a Mr. Horace Scott Laycock, who was the promoter of the syndicate, and was then a director of the newly-formed L.K.W. Syndicate.

Mr. Charles Lille, the manager of the plaintiff company, bore out this statement. He said that throughout the whole of the transactions in dealing with Mr. Crosby, he was under the impression that the L.K.W. Syndicate were liable for the account, and it was not until October 1st that he received any intimation that they were not liable, and that he had to look to Mr. Laycock for payment.

Mr. Thomas H. Crosby, for the defence, said he was the present secretary and manager of the L.K.W. Syndicate. From February 25th to July 28th he was acting as manager to Mr. Horace S. Laycock, at the same hall—the Brixton Hall, now the Khaki Hall. He ceased to be Mr. Laycock's manager on July 28th, when the syndicate came into existence, and the liabilities were taken over by the syndicate, his salary being paid until the end of July by Mr. Laycock, when witness became secretary and manager to the syndicate. The syndicate was registered on May 27th. During the time he was Mr. Laycock's manager the latter obtained a lease of the Brixton Hall as a cinematograph theatre. The electrical arrangements were made by Mr. Naylor, and, as he was unable to carry out the work, he introduced him to Mr. Lille, who was to undertake the installation, under the superintendence of Mr. Naylor. Anything Mr. Naylor passed would be satisfactory to witness. No figures were mentioned, but it was agreed the plaintiffs should have a reasonable profit on work and material, which should be sanctioned by Mr. Naylor.

Judge Parry: Were you asked by anybody who was to be responsible for payment?

Witness: Not directly. Mr. Naylor said I was all right, as he had known me for many years. Certainly the L.K.W. Syndicate was not mentioned as the responsible party to look to for payment.

In answer to the Judge with reference to a cheque for £5 paid to plaintiffs on account, signed by him as secretary and manager of the L.K.W. Syndicate, he said that at the time he was drawing a number of cheques, and this was given to plaintiffs, as Mr. Laycock did not have his cheque-book on him at the time.

Judge Parry said he had the greatest sympathy with witness, as he had great difficulty at the time in finding out who was his employer, whether Mr. Laycock or the syndicate.

Mr. Horace S. Laycock said he was a director of the Montreal-London Development Agency, Ltd., and several other companies, as well as of the L.K.W. Syndicate. He obtained a lease of the Brixton Hall in February, when he gave Crosby certain instructions regarding the electrical fittings. The syndicate was formed on May 27th, and took over the hall on July 29th. He was personally responsible for payment for the work done and now claimed for. He thought the charges were high, and had been willing to come to terms, but plaintiffs refused to do so, demanding the full terms claimed.

In answer to questions, Witness stated he had no legitimate business, such as a bootmaker or butcher, simply being a director in certain companies. He was made a bankrupt in 1905, in 1911 applying for his discharge, which was suspended for a year. He had also one or two County Court judgments against him. Witness added that there was an agreement between him and Mr. Kemp that he should be responsible for all accounts incurred before the syndicate was formed.

Mr. James P. Naylor, an electrical engineer, of West Dulwich, said it was agreed that he should superintend the installation, and

that plaintiffs' account should be submitted to him. He thought 20 per cent. on material and 50 per cent. on labour for the "push job" were reasonable, but the account submitted to him was insufficient to show what had been done.

JUDGE PARRY said he had heard a few unpleasant cases of this kind, but he thought this was the limit. Nobody knew what or who the L.K.W. Syndicate was, but they had the material and the labour and must pay for them. He held that the defendants were liable for the account, and referred to the Registrar the question of the amount, fixing 20 per cent. on material and 50 per cent. on labour as the basis for taking an account of what was due.

BUSINESS NOTES.

British Industries Fair.—The Board of Trade have now completed the arrangements for the holding of a British Industries Fair at the beginning of next year, on lines similar to those which characterised the Fair organised by them at the Royal Agricultural Hall, London, in May of this year. The Fair, which will be opened on Monday, February 21st, and remain open until Friday, March 3rd, 1916, will be held in the buildings of the Victoria and Albert Museum, South Kensington, London, S.W. Only British manufacturers engaged in the following trades, viz., china and earthenware, glass, fancy goods, toys and games, stationery and printing, will be permitted to exhibit. As before, admission to the Fair will be by invitation of the Board of Trade alone, and will be restricted to *bonâ fide* buyers for the trades concerned.

Book Notices.—"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXIV, No. 12. December 1915. New York: The Institute. Price $1.

"*The Mechanical World* Electrical Pocket-Book for 1916." Manchester: Emmott & Co., Ltd. Price 6d. net.

"Aeroplanes and Airships." By W. E. Dommett. London: Whittaker & Co. Price 1s. net.

British Standard Specifications for "Wall Plugs and Sockets" (Report No. 73), and "Charging Plug and Socket" (Report No. 74), of the Engineering Standards Committee. London: The Committee. Price 5s. 3d. and 5s. 4d., post free, respectively.—The Specification for Domestic Wall Plugs and Sockets relates to the five-ampere two-pin type, for pressures not exceeding 250 volts. In view of their extended use, interchangeability is of the greatest importance, and the Committee has, therefore, given this aspect of the question the closest attention. In consultation with the manufacturers, the dimensions necessary to obtain this interchangeability have been agreed upon, the actual design of the plug being interfered with as little as possible. It is of interest to note that the standard plug is required to have side entry for the flexible wire, and a suitable hand shield, as recommended by Mr. Ram, in his reports to the Home Office. In conjunction with the Electric Vehicle Committee of the Incorporated Municipal Electrical Association, the Committee has standardised the essential details necessary to secure interchangeability between any charging plug and any socket of the design selected by the Electric Vehicle Committee. The way is left open for invention and progress, should at any time another type of charging plug be introduced.

"Hazell's Annual, 1916."—London: Hazell, Watson & Viney, Ltd. 3s. 6d. net.

"The *Journal* of the Municipal School of Technology, Manchester.' Vol. VII. Manchester: The Education Committee.

Dissolutions and Liquidations.—CICOY MAGNETO CO., LTD.—This company is winding up voluntarily, with Mr. W. G. Newman, 116, Cannon Street, E.C., as liquidator.

RENEW ELECTRIC LAMP CO., LTD.—Creditors must send particulars of debts, &c., to Mr. J. E. Percival, 6, Old Jewry, E.C., the liquidator, by January 24th.

MARSH, SON & CO., LTD.—A meeting is called for January 25th at 12, Old Square, Lincoln's Inn, W.C., to hear an account of the winding up from the liquidator, Mr. R. W. Brown.

SHEFFIELD ELECTRICAL ENGINEERING CO., LTD.—This company is winding up voluntarily, with Mr. H. Cawood, 68, Eyre Street, Sheffield, as liquidator. A meeting of creditors is called for January 4th at Ashton-under-Lyne. Creditors must send the usual particulars to the liquidator by January 15th.

Fire.—A fire occurred at the premises of Messrs. Claud Hamilton, Ltd., at Aberbeen, on December 23rd.

Bankruptcy Proceedings.—LOUIS ALFRED THOMSON, electrical engineer and contractor, formerly trading at 39, Victoria Street, S.W., under the style of "Saville & Walton."—A sitting of the London Bankruptcy Court was held last week, before Mr. Registrar Linklater, for this public examination. The statement of affairs disclosed total liabilities £3,334 (unsecured £2,922), and net assets valued at £77, after deducting £58 for payment of the preferential claims. In reply to Mr. Egerton S. Grey, Official Receiver, the debtor stated that having been employed for ten years by Siemens Bros. & Co., Ltd., he in May, 1911, joined a Mr. Neale in partnership, and they started business as above, at Bream's Buildings, Chancery Lane, W.C., removing later to Victoria Street, Westminster. Witness was financed by his father-in-law to the extent of £1,000, and Mr. Neale borrowed £200 from his mother. There was no deed of partnership, but each of them drew £5 weekly from the business, which consisted mainly in the installation of electric light and power in works and private houses. The trading was successful, and in 1912 and 1913 branches were opened at Cardiff and Cobham respectively. Mr. Neale retired from the partnership in 1913, and witness took over and continued the business. He paid £100 to Mr. Neale's mother on account of the sum she had advanced for the purpose of capital. The trading subsequently declined; it was further handicapped by trade strikes in January and August, 1914; and then came the war, whereupon he rejoined the Army. A manager carried on the business for him until last May or June, when witness decided to close it till he was again able to give it his personal supervision. He attributed his failure to competition, loss of contracts, lack of capital, and the outbreak of hostilities. The examination was concluded. The following are the principal creditors:—

Unsecured.	
Armorduct Manufacturing Co...	£34
Baldur Engineering Co.	21
British Westinghouse Co. ..	278
Burt, Bolton & Haywood, Ltd...	20
Brimsdown Lamp Co.	13
Barlow Engineering Co... ..	80
D.P. Battery Co.	35
Drake & Gorham, Ltd.	42
Electrical Co.	24
Electrical Apparatus Co. ..	18
Forward Electrical Co.	14
Hann & Ingle	15
Sun Electrical Co...	145
Siemens Bros. Dynamo Works..	105
Siemens Bros. & Co.	96
Stella Conduit Co...	£22
St. Helens Cable Co.	20
Veritys, Ltd...	52
Western Electric Co.	25
Waltardaw Co.	36
Flitton Engineering Co... ..	21
Jap Engine Works	13
Partly Secured.	
Fishenden, Capt.	£1,770
(Security valued at £354.)	
Preferential.	
Rent	£21
Rates, &c.	36

HERBERT PAGE (Smeeton & Page), electrical engineer 63, Queen Victoria Street, London, E.C.—First and final dividend of 6¼d. in the £, payable after January 5th at Carey Street, W.C.

J. W. & T. W. TATTERSALL, electrical engineers, Kimberley Road, Willesden Lane, N.W.—First dividend of 6d. in the £, payable at Carey Street, W.C.

Catalogues and Calendars.—THE RUNBAKEN MAGNETO CO., LTD., Camp Street Works, Deansgate, Manchester.—84-page illustrated and priced catalogue of magneto parts and accessories. Copies will be sent to readers on application.

MESSRS. WILLANS & ROBINSON, LTD., Rugby.—20-page pamphlet containing illustrated descriptive matter relating to the design and construction of their turbine-driven centrifugal pumps.

THE BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, have again issued a large hanging calendar roll with monthly sheets for 1916. As before, on each sheet the dates for the current month are arranged on a large scale prominently placed, the preceding and following months appearing in smaller type. On each sheet there is a photograph of the exterior of the Rugby Works and illustrations of B.T.H. manufactures.

MESSRS. FERRANTI, LTD, Central House, Kingsway, London, W.C.—The firm has now completed the catalogue upon the preparation of which it has been engaged for some time. It is a bulky work in a neat expanding file cover, and has a substantial and plainly printed finger index to sections. These sections are devoted to the following:—House service meters, heating and cooking appliances, static transformers, instruments, switchgear, starters and controllers, panels and sundries. Under the division sheet of each section there is an index and discount sheet. Each list number is made up on a system which is explained at the beginning of the book, as is also the system upon which the cable code-words are compiled. In addition to descriptive matter relating to the manufactures mentioned, prices, and particulars of dimensions and weights are tabulated. Well-executed illustrations are included in every section. The work involved in the preparation of the catalogue must have been enormous.

THE CONSOLIDATED PNEUMATIC TOOL CO., LTD., of 9, New Bridge Street, Westminster, S.W., have prepared a wall calendar with monthly sheets for 1916. Each sheet contains a picture of a grinder, rivetter, compressor, drill or some other tool of which the company makes a speciality.

THE KEY ENGINEERING CO., LTD., of Trafford Park, are circulating a celluloid vest-pocket calendar for 1916.

MESSRS. J. E. & S. SPENCER, 16, Dowgate Hill, Cannon Street, London, E.C.—Circular giving net prices for cutting-out and screwing w.i. tubing up to 6 in. diameter at their London warehouse, where they have put down new machinery.

Trade Announcement.—On January 1st MESSRS. MITSUBISHI GOSHI KAISHA will open at 149, Leadenhall Street, E.C., a branch office of their Tokyo business. In addition to their operations as bankers and merchants, they are producers of Japanese steam coal, electrolytic copper, Wolfram and tin ores, and other metals; steamship owners; proprietors of the dockyards, shipbuilding, and engineering works at Nagasaki and Kobe; iron founders; paper-makers; owners of public wharves and warehouses and real estate; refiners and exporters of Chinese oils and cereals, &c. They have branches and agencies in all the important cities in Japan, and in Shanghai, Hankow, Peking, Hong-Kong, Singapore, Manila, Vladivostock, and Glasgow.

Prices Advance.—THE ELECTRIC & GENERAL WORKS, LTD., of Victoria Street, S.W., announce a further increase of from 20 to 25 per cent. in catalogue prices for switchgear as from January 1st.

New Manufacturers' Association.—The British Manufacturers' Association, 1915, has been formed with offices at Lincoln House, High Holborn, W.C., with Mr. R. G. Cheesman as chairman. It is to be formed exclusively of British manufacturers, and is to be run on purely business and non-political lines in the interest of Empire manufacturers. One of its chief aims is to secure the appointment of a business man as Minister of Commerce.

Exports to Switzerland.—The import into and transit through Switzerland of electrical and other goods have been placed, since November 16th, under the control of a society established at Berne under the name of the Société Suisse de Surveillance Economique. Permits for exportation of goods to or transmission through Switzerland must be obtained from this Society without which no shipments or transit traffic will be allowed. Previous or unsuccessful applications to the Inter-ministerial Commission must now be renewed with the above Society. A reference to the matter appears in our "War Items" to-day.

LIGHTING AND POWER NOTES.

Aberystwyth.—PRICE INCREASE.—Owing to the advance in the price of fuel and the increase in wages, the Chiswick Electricity Supply Corporation, Ltd., announces that until further notice accounts for current will be increased by 10 per cent., as from the date for reading meters for the December quarter. Meter rents will remain as heretofore.

Australia.—The West Guildford (W.A.) Roads Board has made arrangements to purchase electricity in bulk from the Government in connection with the Perth plant.

The Claremont (W.A.) Council, which already has an electric generating plant, has been approached by the Perth electricity department regarding the supply of current in bulk at 1¾d. per unit, low tension, "providing the Council will give the Government the right to supply direct any power consumers in the district."

At Tumut (N.S.W.) a local syndicate proposes to install a hydro-electric plant in order to provide power for timber cutting and other works. The State Government is to be approached respecting the water rights.

The Katoomba (N.S.W.) Municipal Council has decided to discard the old steam pumping plant at the waterworks, and obtain electric power from the Katoomba Electric Supply Co., at the rate of 1d. per unit. The company is also to obtain certain water concessions.—*Tenders.*

The Shire Councils of Flinders and Alexandria (Victoria) have instructed Messrs. McCarty, Underwood & Co., of Melbourne, to furnish a report on the electric lighting of Sorrento and Alexandria.

The Townsville (Queensland) City Council has requested Messrs. Wylde, Ball & Co., of Brisbane, to report on an electric lighting scheme for the district.

The Mount Gambier (South Australia) Council has entered into arrangements with Messrs. Bridger, Ltd., of Adelaide, for the installation of electricity in the town.—*Tenders.*

Barking.—The local Ratepayers' Association has passed a resolution asking the U.D.C. to apply for powers to supply electrical fittings free of charge, and to add a small sum per unit for current to meet the cost. It is considered that by this means electricity would be used in the homes of many working men.

Batley.—The Electric Lighting Committee has decided that for the future a charge of 5s. per yard, or part thereof shall be made for all lighting services in excess of 20 yards; that the wages of shift engineers be increased to 36s. per week of 56 hours, and that a Development Sub-Committee, consisting of eight members, be appointed.

Bradford.—MAINS EXTENSIONS.—Important extensions of electricity mains have been decided upon by the Electricity Committee, along Canal Road to Bolton Lane abattoir (including switchgear), at a cost of £2,856; from Thornbury sub-station along Leeds Road to the city boundary (including switchgear for the Yorkshire Electric Power Co.), £883; to Bowling Iron Works (including transformer chamber equipment for Messrs. Bever, Dorling & Co., Ltd.), £498; and several smaller extensions.

The Electricity Committee has authorised the Common Seal to be affixed to agreements for bulk supply to a new company at Bolton Lane abattoir; and with the Yorkshire Electric Power Co. and Messrs. Bever, Dorling & Co., Ltd.

Castlewellan (Co. Down).—E.L. SCHEME.—The new electric lighting system for the town, introduced by the Irish Towns Light and Power Co., Ltd., has been officially opened. The arrangement with the local Committee is to provide 40 street lamps for lighting from September to March, at a cost of £1 per light, with 6d. per unit for private lighting, and 3d. per unit for power purposes.

China.—TSINGTAO.—According to a report by the U.S. Consul, in the Government electric light works there are two dynamos of 170 KW. capacity and one of 410 KW., while a third of 1,000 KW. is being ordered from Japan to provide for extension of the service to the suburbs. The works employ a staff of about 103 men, and the monthly receipts from sales of current are about $2,500. The fixed rate per lamp ranges from c. 41 per month for a 10-C.P. lamp to $1.85 for one of 400 C.P. The charge per KW.-hour ranges from c. 9 for a total consumption per month of less than 50 KW.-hours to half that rate when more than 400 are consumed; there are also minimum charges per number of lamps for each subscriber. Current for motors is charged for on a sliding scale, ranging from $2.68 per month per H.P. to $2.16. Rent is charged for meters, as these are the property of the Government. Two electric light plants are located at Syfang and the Hungshan coal mines respectively, the former in the Shantung Railway's car shops, and the latter in the railway's mines. The supply in Tsingtao is A.C. with a frequency of 50 and a voltage of 120.—*Eastern Engineering.*

Church Stretton.—PROV. ORDER.—The local Electric Supply Co. has applied for a provisional order for electric supply in the urban district of Church Stretton, and the parishes of All Stretton and Little Stretton, in the rural district.

Dodworth.—At a meeting of the Urban District Council, upon it being stated that the application of the Electrical Distribution of Yorkshire, Ltd., in respect of a provisional order for lighting in various Yorkshire areas, had been adjourned until after the war, it was stated that the Council had no option but to use gas, being tied to the local gas company for a period of 14 years, five of which had expired. What was wanted was competition with the monopoly of the gas company.

Ecuador.—A decree has been published providing for the raising of certain funds for the installation of an electric lighting system in the town of Tulcán.

Greenock.—PROPOSED LOAN.—The Corporation is to apply to the Scottish office and the Treasury for authority to borrow an additional £40,000 for electricity purposes.

The Electricity Committee has received permission to contract for a cooling tower at an outlay of from £1,500 to £1,600.

Haslingden.—SERVICE COSTS.—The Tramways and Electricity Committee has decided that, during the continuance of the war, or until further notice, the whole cost of any service for a supply of electricity shall be borne by the prospective consumer, subject to any special arrangements. The Corporation will supply up to 8 ft. of cabling on private premises.

High Wycombe.—STREET LIGHTING.—The T.C., in order to come to an amicable agreement with the E.L. Co. regarding restricted public lighting, has decided without prejudice to agree to a reduction of £600 in the charges for the year, instead of the £700 originally sought. The Council also agrees to the contract being extended for three years beyond the termination of the existing contract.

Ilford.—DESTRUCTOR POWER PLANT.—With reference to the electrical equipment of the proposed engine room at Seven Kings dust destructor, for which a loan has been refused, the U.D.C. has informed the L.G.B. that the best arrangement under existing conditions, and entailing the least capital expenditure, is to transfer from the Ley Street works the two 200-KW. sets, together with switchboard panels, to install a 10-ton overhead travelling crane, and to lay a four-way duct and cables from the engine room to the Ley Street works, connecting to the main switchboard. The approximate cost is £3,100, and a loan for this is to be again applied for. The U.D.C. has fixed the price of current for the tramways for the year ended last March at 1½d. per unit net.

Keighley.—Subject to the approval of the T.C., it has been decided to install electric light at the Keighley Museum, in Victoria Park.

London.—Seventy feet of electric cable was destroyed, three distributing boxes were blown into the air, and 40 ft. of pavement, 10 ft. wide, was hurled in all directions by a recent explosion in the mains in Rotherhithe Street. A second explosion occurred as a fire engine drove up, and the driver was injured.—*Evening News.*

WOOLWICH.—The B.C. has received formal sanction from the L.C.C. for the borrowing of £4,700, required for the purpose of defraying expenditure in linking-up with the South Metropolitan Electric Light and Power Co., Ltd.

Maidstone.—PRICE INCREASE.—The T.C. announces that owing to the increased cost of coal, the charges for current for lighting will, from the New Year, be increased as under:—Flat rate, from 4¼d. to 4½d. per unit; maximum demand, from 7½d. and 2¼d. to 7½d. and 2½d.; telephone system, from 8s. per 30-watt lamp per annum, and 1¼d. per unit to 8s. and 1½d.; fixed charge, from 11s. per 30-watt lamp per annum to 11s. 6d. The charges for other services remain unaltered.

Manchester.—FURTHER LIGHTING RESTRICTIONS.—Efforts have recently been made with a view to securing permission for increasing the lighting of the city, and hopes were held out that some satisfaction would be gained. On Monday, however, it was announced that a more rigorous restriction of lighting would come into force on January 10th in the areas of Manchester, Salford, and Stretford (which includes Trafford Park).

Apropos of the reference last week to the threatened shortage of coal, it may be added that it has since been reported that considerable relief has been secured as a result of pressure by the Government in the necessary quarter, and the action of the Electricity Committee in going further afield for supplies.

Middlesbrough.—The gross profit on the working of the Corporation electricity undertaking for November has been estimated at £1,940, an increase of £336, as compared with the corresponding period last year.

The Corporation has arranged to take over the lighting order for North Ormesby (recently amalgamated) from the Cleveland and Durham Electric Power Co., as from January 1st. It had been agreed to pay £986, but since the agreement a further £101 ha

been spent on mains, &c., and it has been decided to add this to the amount to be paid by the Corporation.

Loan Application.—In reply to an application for sanction to borrow £43,000 for mains, meters and fittings, the L.G.B. has sanctioned the borrowing of £3,994 for mains, and £1,159 for meters and fittings, these representing amounts already spent, but has intimated that no new mains should be laid except for special purposes.

Morley.—Year's Working.—The annual accounts of the Corporation show that, for the year ended March 31st last, the deficiency on the electricity undertaking had been reduced to £301, it having been £443 at the end of the preceding year, and £783 in 1912. The total expenditure during the period under review was £4,227, and the receipts £3,925. Coal accounted for an expenditure of £715; wages, £778; cost of distribution, £351; interest on loans, £784; and sinking fund charges, £1,146.

New Zealand.—In his annual report the general manager of the Wellington tramways department states that consideration will shortly have to be given to the best and most economical means of generating and transmitting power to outlying districts, more particularly South Wellington and adjacent suburbs. The electrical engineers of both the tramways and lighting departments have been requested to report fully on the matter and to consider the advisability of installing such additional generators as may be required to supply both undertakings. As this would necessitate the use of alternating plant, it will give rise to the question as to where such machinery should be installed, and whether a new building should be erected capable ultimately of housing the whole of the machinery for both systems. The general manager states that consideration should be given to the possibility of a hydro-electric scheme being adopted for the supply of electricity for all purposes in the city, in order that all extensions may be utilised in connection therewith.—*Board of Trade Journal.*

Portadown.—Mr. D. Chapman has intimated to the Council that, owing to the increased cost of coal and oil, he has been obliged to advance the price of electric light by 15 per cent. Mr. W. J. Johnston said the Council had a guarantee from Mr. Chapman not to increase the price for five years.

Portpatrick.—The Rhins District Committee of the Wigtownshire C.C. has agreed to offer the Portpatrick E.S. Co. £35 in respect of street lighting between September 20th, 1914, and February 4th last; it had been proposed to offer £25, but the company considered this inadequate.

Spenborough.—The Electricity Committee of the Urban District Council has authorised the electrical engineer to refuse any application for power purposes except in special cases. This decision has been come to on account of the electricity works being at present loaded to their full extent.

Torquay.—It is understood that the Tramways Co. objects to the payment of the increase of ½d. per unit made by the T.C. for energy used, and intends to submit the question to arbitration in accordance with the terms of the contract.

Weymouth.—Year's Working.—The annual report of the borough electrical engineer for the last completed year shows that 920,769 units were sold as against 863,705 in the previous year; 103 motors of 515 H.P. and 145 KW. of heating apparatus are connected to the mains, the total connections in equivalent 33-watt lamps amounting to 51,894. The maximum load was 554 KW. and the load factor 18·97 per cent. The gross profit amounted to £3,868, and after meeting interest and loan charges there remained a deficit of £252, which, except for £20, was met by the reserve fund. The war has adversely affected the revenue of the undertaking, and the increased expenses give little hope of profitable working under present conditions.

Wirral.—Prov. Order.—The B. of T. has informed the R.D.C. that its consent to the prov. order for E.L. applied for in regard to the parishes of Eastham, Little Sutton, and district is not necessary at present, as the order will not be allowed to be proceeded with until after the end of the war.

TRAMWAY and RAILWAY NOTES.

Australia.—A report on the proposed electric tramway from Melbourne, through West Brunswick and West Coburg, has been prepared by Mr. V. J. Crowley, consulting engineer; the suggested route is 8 miles 23 chains, the capital cost by the Royal Park route is estimated at £123,000, and the estimated yearly loss £838; by the alternate route the capital cost would be increased by £10,850, and the gross yearly loss to £1,814.—*Melbourne Age.*

Electric Vehicles.—The Sydney City Council has ordered three Baker electric trucks fitted with Edison A 10 cells, at a cost of £1,180 each.—*Tenders.*

Blackpool.—Contract Tickets.—For some time the Tramways Committee has been considering the question of contract tickets which for many years have cost £3 for the whole system. Mr. Furness, the general manager, reported that the loss on these contracts were over £2,000 per annum, and he suggested the price be raised to £4 10s. There was an immediate outcry. On December 23rd Mr. Furness suggested contracts should be abolished altogether. This, however, was not adopted, the Committee deciding to continue contracts on the old basis of £3 per annum.

The monthly returns of the Corporation tramways for November show an increase of £188 in receipts, despite the suspension of annual and other tickets pending a decision on the subject. The receipts from April 1st have been £67,405, an increase of £1,638.

Bradford.—Auxiliary Car-Drivers.—In response to the Tramway Committee's appeal to public-spirited citizens above military age who were willing to assist in the running of the tramways, 150 applications have been received. Those who pass the necessary medical examination are to be trained as auxiliary drivers on lines which have proved very successful at Birmingham.

An application has been made to the Tramways Committee, on behalf of the tramwaymen, for an advance of 5s. per week for employés paid weekly and 1d. per hour additional for those paid by the hour, this to take the place of the bonuses of 1s., 2s., and 3s. granted by the Corporation. If this advance is acceded to it will mean an additional expenditure of £12,000 per annum.

In consequence of the decision of the Tramways Committee to engage women as conductors, some 100 applications have been sent in for appointment, and an experiment with 20 female conductors is to be made. In this connection it is interesting to note that already 689 men have left the Bradford tramway department for service with the Army, and 550 of the remaining 818 of military age have been attested under Lord Derby's scheme. It is stated to be absolutely necessary that the present staff of 1,281 employés should be retained if the present service is to be maintained. The department is paying sums totalling £8,000 to dependents of employés on service, and, in the event of further numbers being called upon, this figure is likely to be increased threefold.

The Tramways Committee has appointed a Special Sub-Committee to inquire into the whole question of tramway track construction and maintenance, with authority to visit other towns to make inquiries into the matter and to report.

It has been agreed that when prices become normal again the Corporation shall include in the next Parliamentary Bill clauses empowering it to construct and work the Baildon tramway itself.

Continental.—Sweden.—Railway Electrification.—According to a report presented to the Government of Sweden by the State Railway Administration in November, the working of the line between Kiruna and Kiksgransen has fully corresponded to the requirements. This railway, which was converted from steam to electric traction in January, 1915, has a total length of 80 miles. It is operated by means of single-phase locomotives which haul goods trains each conveying 2,000 tons of iron ore, in addition to passenger trains. As sufficient experience is said to have now been gained with the system used, the Railway Administration recommends that the transformation of the section between Kiruna and Svarton (Lulea) should be undertaken. In this event the whole of the mileage used for the carriage of iron ore in this part of Sweden would be provided with a uniform system which would permit of greater economy in working and an increased utilisation of the plant at Porjus Falls station, which supplies energy to the first-mentioned line.

Switzerland.—Electrification of the State Railways.—The problem regarding the proposed conversion of the Swiss State Railways to electric traction is beginning to assume a more definite stage. Early in December an important conference was held at Berne, at the instance of the Swiss Association for the Regulation of Water Powers and the Association of Electrical Engineers, under the chairmanship of Prof. Landry, President of the latter Association, to discuss the question of the electrification of the Federal Railways. Among the 250 persons present were representatives of all the transport undertakings, including members of the general management of the Swiss Federal Railways, and of the Federal Council of Government Departments. M. Thormann, the engineer who was in charge of the work of transforming the Lotschberg Railway, delivered a lecture on the various systems of electrical working, and proposed the adoption of the single-phase method, which has given every satisfaction on the Lotschberg Railway. After discussion, a resolution was passed expressing a hope of the speedy conversion of the St. Gothard Railway and of the approach lines, together with the approach lines to the Simplon Railway, the conference being convinced of the advantages which would result from the better utilisation of the existing water powers by assisting in rendering the country independent, from an economic point of view, in regard to supplies of coal for railway working. The subject was also raised on December 15th, at the sitting of the Standerat, in connection with the consideration of the State Railway Estimates for 1916. M. Forrer, in reply to questions, stated that the matter of electrification now stood in the foreground of public interest, and the Federal Council shared the opinion that a forward step should be quickly undertaken. The work would involve an expenditure of nearly £20,000,000, but it would contribute towards securing the independence of the country. The Federal Railway Administration and the Railway Department would have to decide the problem of the particular system to be adopted, although members of the Standerat have also the right to express their views, as they would have to sanction the necessary credit votes. A decision as to the system was still outstanding, but M. Forrer declared that it would have to be settled by the end of 1916 at the latest, before the erection of the power station was commenced.

GERMANY.—Since the outbreak of war the number of tramway accidents has shown an alarming increase, due chiefly to taking experienced motormen and conductors for the Army, and filling their places with unskilled men. Statistics published in Munich show that in the period between the beginning of the war and December 8th, 1915, there were 425 collisions between tramcars, 120 of these between August 1st and December 31st, 1914, and 305 between January 1st and December 8th, 1915. In the same five months—August to December, 1913—there were only six collisions. The collisions between tramcars and wagons and other vehicles also show a tremendous increase in the last 16 months. The municipal authorities have decided to appeal to the military commandant to release motormen and conductors who are merely performing garrison duty, and permit them to return to work.

Edinburgh.—At a meeting of the Tramway Committee on Thursday, Mr. Hamilton, of Leeds, was present, and the proposed agreement between the Corporation and the Tramway Co. was discussed.

Glasgow.—WOMEN DRIVERS.—The Tramways Committee is proceeding with a scheme for utilising female labour in substitution for male. Already several hundred women are employed as car conductors and car cleaners. Protests have, however, been received from labour organisations with regard to the employment of women as "motormen." Some time ago Mr. Dalrymple, the general manager, with the consent of the Committee, trained five young women for the work of the driving platform, and after serving a probationary term they were put in charge of cars. So successful has the experiment proved that it is now proposed to train a number, not exceeding 30, of additional women to enable the manager, should the occasion arise, to advise the Committee on the advisability or otherwise of employing women as car drivers.

Halifax.—FEMALE LABOUR.—During the course of a discussion on the appointment of women as conductors on the Halifax cars, a deputation from the Tramwaymen's Union was informed that it was not the intention to continue the employment of women on the tramways after the termination of the war.

Newcastle-on-Tyne.—A landslide took place on the 27th inst., on the North-Eastern Co.'s electric railway, at Lants Quarry, between St. Peter's and St. Anthony's stations, near the River Tyne; a portion of the railway embankment slid away, leaving the railway track suspended in the air.

Stockport.—STRIKE.—About 30 men employed in the car depôt came out on strike on Tuesday, because their demand for a bonus on similar lines to that granted to car drivers had not been acceded to. The Tramways Committee had suggested a revision of wages, but the depôt men would not agree to that.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Public Works Committee of the Federal Parliament has submitted its report upon proposals to establish further automatic telephone exchanges. The savings effected where the automatic system has been installed tend to show that, although the cost of installation is much higher than is the case with the manual system, under the full automatic system the working cost on each line would be reduced approximately £1 a line a year.

It is estimated that the Sydney Exchange will cost £116,801 for 5,000 lines, or £339,899 for 20,000 lines. The immediate suggestion is to install a switching equipment of 5,000 lines. At the time of transfer it is estimated the revenue will be £5,180, and with 20,000 subscribers, £185,000.

For Malvern, also, will be installed an automatic switchboard, having a present capacity of 3,600 lines, but capable of extension to 7,500 lines. The immediate cost of the work is estimated at £46 933. The estimated revenue with 3,600 subscribers connected is £23.940. The Committee expresses its approval of the proposals.

The Collingwood station also will be a new one with a present capacity of 3,400 lines and an ultimate capacity of 9,000 lines. The estimated immediate cost is £49,752. The revenue is estimated as £22,610, with 3,400 subscribers connected.—*Australian Mining Standard.*

Berlin-Sofia. — Direct communication by telephone between Berlin and Sofia, Bulgaria, has been opened.—*T. and T. Age.*

Duplex Marconi Wireless.—The trans-Atlantic wireless circuit between Louisburg, Cape Breton and Clifden, Ireland, is being operated automatically as a duplex, the Wheatstone being used for transmission and the Dictaphone for reception.—*T. and T. Age.*

Long-Distance Wireless.—On November 29th an operator of the Federal Wireless Telegraph Co., at Honolulu, Hawaii, picked up messages transmitted from Nauen, Prussia, to Tuckerton, N.J., approximately 9,000 miles away. It is stated that the signals, as received, were very clear.—*T. and T. Age.*

Russia.—A temporary interruption in telegraphic communication between England and Russia last week was removed at the week-end.

Telephonic Interruptions.—A violent storm on Monday night brought down numerous telephone wires in various parts of the country, and communication between London and important provincial towns was in many cases restricted or completely interrupted. Communication between Cardiff and Birmingham, Liverpool and Manchester was stopped.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—ADELAIDE.—January 19th. P.M.G. Common-battery switchboard. See "Official Notices" November 19th.*

January 26th. Deputy P.M.G. Twenty tons of galvanised-iron wire, 400 lb. to the mile.*

January 26th. Deputy P.M.G. Telephone instruments, parts and accessories.*

BRISBANE.—February 23rd. P.M.G. Wheatstone apparatus. See "Official Notices" Dec. 17th.

April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" to-day.

SYDNEY.—January 31st. Three electrically-operated railway freight-car transferers, for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

Bristol.—January 4th. Electric fittings for six months, for the B. of G. Mr. J. J. Simpson, Clerk, St. Peter's Hospital.

Darlington. — January 12th. Corporation. Coal bunkers, elevators, &c., for the electricity works. Specifications from the Borough Electrical Engineer, Haughton Road.

London.—ST. PANCRAS.—January 10th. B.C. Steel constructional work (power-house extension) for the Electricity Department. Specifications (£1) from the Borough Electrical Engineer, 57, Pratt Street, N.W.

HAMPSTEAD.—January 6th. B.C. Electrical engineer's stores, oils, &c. Particulars from the Town Clerk, Town Hall, Haverstock Hill, N.W.

ISLINGTON.—January 21st. B.C. Twelve months' supply of engine-room stores, electrical fittings, meters, cables, &c. See "Official Notices" to-day.

Manchester.—January 5th. Alterations and additions to pipework and condensing plants for Nos. 13 and 15 turbines, Stuart Street station. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

Newton-in-Makerfield.—January 3rd. U.D.C. Two Lancashire boilers, one steam-driven gas exhauster, one 25-H.P. D.C. electrical set. Specification from Mr. R. T. Surtees, Gas Works, Newton-le-Willows.

New Zealand. — AUCKLAND. — February 23rd. City Council. Centrifugal pumping electric motors, and automatic starting and controlling apparatus, for the four city pumping stations. Specifications from the office of the Water Board, Town Hall, Auckland.

DUNEDIN.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

RAETIHI.—March 14th. Town Board. 40-H.P. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

South Africa.—DURBAN.—January 5th. Corporation Telephone Department. (1) Telephone apparatus and materials; (2) underground cables; (3) 540 c.i. pipes, 9 ft. long, for cables. Messrs. Webster, Steel & Co., 5, East India Avenue, E.C., are the Corporation's London agents.*

Spain.—January 20th. Installation and working of an electric lighting system at Segovia for five years, for the municipal authorities.*

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Aldershot.—The U.D.C. has accepted the tender of Messrs. Spencer, Whatley, Ltd., for the supply of 1,500 tons of Griff peas coal, at £1 3s. 3d. per ton, for the electricity works.

Australia.—The following tenders have been accepted :—

VICTORIAN RAILWAYS DEPARTMENT.

15 tons of galvanised telegraph wire, £257.—The Whitecross Co.

PUBLIC WORKS (SHIPYARD), WILLIAMSTOWN.

Motors for machine tools.—Gardner, Waern & Co., £148; Aust. General Electric Co., £231.

N.S.W. PUBLIC WORKS DEPARTMENT.

Switchboard for Port Kembla power station.—Panels 1 and 2, and additions to existing panel, £358, Aust. General Electric Co.; panels 3 and 4, £290, Haes & Eggers, Ltd.

WEST AUSTRALIA TENDER BOARD.

Static transformers (Railway Department), 80 K.V.A. and 200 K.V.A., £331.—J. R. W. Gardam.

SOUTH AUSTRALIA SUPPLY AND TENDER BOARD.

20 tons of copper wire, £2,170.—Harris, Scarfe & Co.

SYDNEY CITY COUNCIL.

The Electricity Committee recommends that the tender of Messrs. N. Guthridge, Ltd., be accepted for a 2,000-KW. motor-converter constructed by Messrs. Bruce Peebles, Ltd., at £8,257; and that tenders for motors for hiring out be accepted as follows :—

Sections A, B, C and D.—Aust. General Electric Co. Tender "A" for motors manufactured by the General Electric Co. of U.S.A., and tender "C" for starters manufactured by the B.T.H. Co.

Section E.—Aust. General Electric Co. Tender "A" for motors and starters manufactured by the G.E. Co. of U.S.A.

Section F.—Standard Waygood Hercules, Ltd., for motors and starters manufactured by the British Westinghouse Co.

And that the following initial orders be given :—

Section A, motors £923, starters £57. Section D, motors £1,437, starters £155. Section E, motors £2,028, starters £543.—Aust. Gen. Elec. Co.

Section F, motors £122, starters £63.—Standard Waygood Hercules, Ltd.

Also that 58 motors, at prices 30 per cent. in excess of the contract which expired on October 8th, be obtained from Standard Waygood Hercules, Ltd., at £2,996; and that additional switchgear and transformers be obtained under existing contracts from N. Guthridge, Ltd., £1,438; British General Electric Co., £457; British Westinghouse Co., £502; Aust. General Electric Co., £441.

—*Tenders.*

PUBLIC WORKS DEPARTMENT, SYDNEY.

104 A6 Edison cells, in four batteries of 26 cells each, for the Newcastle workshops, £551.—Standard Waygood Hercules, Ltd.

—*Sydney Evening News.*

MELBOURNE.—**The Melbourne, Brunswick and Coburg Tramways Trust** has accepted the tender of Messrs. Burt & Timms, at £27,863, for construction of the permanent way.

Ilford.—The tenders of Messrs. W. T. Henley's Telegraph Works Co., Ltd., have been accepted by the D.C. for the supply of 3,387 yards of triple-concentric cable, at £2,260, and for joint boxes, at £59. Eleven tenders were received.

Ryde.—The T.C. has accepted the tender of Messrs. Ruston, Proctor & Co., Ltd., for a semi-Diesel engine for pumping purposes, at £298.

FORTHCOMING EVENTS.

Rontgen Society.—Tuesday, January 4th. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "Some Observations upon the Occurrence of Uranium," by the President, &c.

Royal Institution of Great Britain.—Tuesday, January 4th, Thursday, January 6th, and Saturday, January 8th. At 3 p.m. At Albemarle Street, Piccadilly, W. Christmas Lectures for Juveniles, "Wireless Messages from the Stars," by Prof. H. H. Turner.

Greenock Electrical Society.—Friday, January 7th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "The Economy of Electricity in a Small Household," by Mr. W. B. Smith.

Electro-Harmonic Society.—Friday, January 7th. At 8 p.m. At Holborn Restaurant. Smoking concert.

Manchester Association of Engineers.—Saturday, January 8th. At Grand Hotel, Aytoun Street. Paper on "The Importance of Uniform Conditions for Engineering Operations and Industrial Work," by Mr. A. Etchells.

NOTES.

A Happy New Year!—We wish all of our readers—manufacturers, professional and commercial men, electrical engineers engaged in munitions production at home, and friends in the Fleet or in the trenches—all the good that they can wish for themselves in 1916. May the Victory of the Allies not be long deferred, permitting the electrical industry to return to its normal interests and activities.

Russian Iron for Electrical Purposes.—In 1913 the quantity of iron imported into Russia for the construction in that country of electrotechnical apparatus amounted to a total of 4,000 tons. Investigations recently carried out have shown that in the Urals there are large reserves of iron which, suitably treated, would serve quite successfully for this purpose, not only as a constructional material, but also in respect of its magnetic properties. It is hoped that in the future Russian iron will take the place of German iron in the national electrotechnical industry.

Chain Screen Doors for Furnaces.—Everyone who has had to work round ovens and furnaces knows what discomfort has to be endured by the attendants from the heat when the doors are thrown open, and, further, what a chilling effect the inrushing cold air has upon the interior of the furnace and its contents. Doors, however, must be opened, be it to renew the charge, manipulate the contents, or study the interior conditions.

The Wiegand chain screen doors, in the form used mostly around glass, metal and chemical furnaces, consist of a multitude of freely hanging individual strands of steel chain suspended close together from a steel bar in a manner to form a continuous sheet or curtain of chain, not unlike the familiar Japanese screen.

This curtain effectively hinders the heat from leaving the furnace and the cold air from entering. The loosely hanging strands are parted with ease and pressed aside by the tools or other objects projected into the furnace, falling together again afterwards.

The holes in the links of chain permit an unhampered view of the interior—in fact, a better survey than under ordinary conditions may be obtained, as the glare is toned down, and the effect is similar to looking into the furnace through a piece of wire gauze.

The doors are supplied in "automatic" and "non-automatic" forms. The automatic is employed mostly on boiler furnaces, where the opening of the ordinary fire door causes the screen to unroll from a cylinder hung above the furnace opening. The non-automatic, which is much used on ovens and other furnaces, is much simpler in construction. The chains forming the screen are suspended from a bar and may be raised out of the way by a hand chain running through a pulley overhead. When needed, the screen is lowered into supporting brackets fixed at the sides of the opening.

These chain screen doors are the result of several years of experimentation, having been first adapted for use on boiler furnaces, where they have been in practical operation for three years. They are made by the E. J. Codd Co., Baltimore, Md., U.S.A.—*Metallurgical and Chemical Engineering.*

Reinforced Concrete Construction.—The *London Gazette* for December 28th contains the full text of the regulations made by the London County Council, and confirmed by the Local Government Board, for the use of reinforced concrete in building construction. The regulations are very detailed, and include technical data and formulæ to be used in calculating bending moments, resistance moments, permissible loads, &c.

An Excellent Record.—At the outbreak of the war the Calico Printers' Association, Ltd., of Manchester, had a staff of 37 electricians engaged on maintenance work. Within the first two months 15 joined the Forces, and within the first six months 10 left to take up various grades of work for the Government. There then remained a staff of 12, nine of whom have attested, the remaining three being over military age. Out of the nine attested men the Association is hoping to retain at least five to enable the electrical department to continue its operations. How important these operations are may be gathered from the facts that all the engineering shops, many of which are electrically operated, are working at full speed; over 400 dynamos and motors, representing between 11,000 and 12,000 H.P., are daily at work, and some 600 miles of wire and 30,000 lights have to be maintained. We recently recorded that a late member of the staff had been granted the "Croix de Guerre" for gallantry in France. The department certainly seems to be "doing its bit."

New Motor-Car Lighting Regulations.—Under the new motor-car lighting regulations which come into force on January 10th, not only are all headlights prohibited, but it is provided that, where electric side lamps are used, the bulbs must not exceed 12 watts, or give, in use, a greater candle-power than a 12-watt bulb, as standardised for side lights by the Engineering Standards Committee. The front glass, if circular, must not exceed 6 in. in diameter, and, if rectangular, the longer side must not exceed 6 in. The whole of the front glass must also be obscured with one thickness of ordinary white tissue paper. In certain scheduled areas the light must be further obscured by disks of cardboard or opaque material in which are pierced six small holes.

Institution and Lecture Notes.—Diesel Engine Users' Association.—At the December meeting of the Association, Mr. Geoffrey Porter, borough electrical engineer to the Worthing Corporation, was elected President; and Messrs. C. O. Milton (Maidenhead), C. Gould (Letchworth), and H. Leslie Dixon (Leatherhead), were elected members of the Committee. Mr. Percy Still (Chelsea) was elected as Honorary Secretary. The Acting Hon. Secretary for the current year stated that there had been an increase during the year of 19 members, the total membership to date being 48, and representing 104 Diesel engines, having a total horse-power of 23,984. During the year 1915 a work of considerable importance had been accomplished in drawing up a standard form of policy of insurance against breakdown specially applicable to Diesel engines, in conjunction with Messrs. Bankes, Warner & Co., Ltd. Under this arrangement preferential terms are granted to members of the Association, or to the undertakings for which they act. The scheme also provides for inspection of engines and full reports by engineers who have made a special study of Diesel engine plant. The subject of income-tax assessment, and of the allowance made for depreciation by the Inland Revenue Authorities, also received careful consideration. Before the conclusion of the meeting, the retiring President, Mr. J. E. Edgcome, referred to the rapid growth of the Association from small beginnings, and spoke of the work carried out, which had proved useful, not only to users of Diesel engines, but also to engine makers and others interested in the industry. The next meeting will be held on January 19th, 1916, when the subject of the possible use of "Tar Oils and Fuel Oils from other Sources" will be considered.

Electrical Association of Australia (Victoria Section).—The Council reports that 22 members of the Association have joined the Expeditionary Force. One, Lieut. R. T. Watts, died as a result of wounds received at the landing at Gaba Tepe. Mr. E. H. W. Westwood has resigned his office as secretary, owing to military duties. The average attendance at meetings has been 51·8 members and visitors. The scheme for licensing wiremen, which was delayed by unforeseen circumstances, will be submitted in the near future.

Association of Mining Electrical Engineers.—At a recent meeting of the Yorkshire Branch, at Sheffield, a paper was read by Mr. Andrew Gibson, of Glasgow, on "Bearings of Electrical Machinery." He said that ball bearings fulfilled better than any other type the principal aim of bearings—to reduce friction to a minimum. Properly installed, ball bearings required very little attention and very little oil, but it was essential that they should not be allowed to run dry.

Royal Society of Arts.—The following are included among the arrangements for meetings during January and February, 1916:—

Wednesday, January 5th, 3 p.m. (Juvenile Lecture.) Prof. John M. Thomson, LL.D., F.R.S., "Crystallisation." (With experiments.)
Wednesday, January 12th, 3 p.m. (Juvenile Lecture.) James Swinburne, F.R.S., "The Science of Some Toys."
Wednesday, February 9th, 4.30 p.m. (Ordinary meeting.) Prof J. A. Fleming, F.R.S., "The Organisation of Scientific Research."

Volunteer Notes.—Engineering Institutions' Volunteer Engineer Corps.—Orders for week commencing January 3rd, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, January 3rd.—Sections 1 and 2, Technical; Sections 3 and 4, Squad, Signalling Sections and Recruits.

Tuesday, January 4th.—School of Arms with Architects Corps, 6 to 7 p.m.

Thursday, January 6th.—Sections 1 and 2, Shooting.

Friday, January 7th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad, Signalling Sections and Recruits.

Officer of the Week: Monday, January 3rd, 1916, to Saturday, January 8th, Mr. L. C. Hughes-Hallett.

Platoon on Duty.—Monday, January 3rd, to Saturday, January 8th.—No. 1 Platoon.

Platoon on duty to provide a piquet for Headquarters of one N.C.O. and three men, and also one N.C.O. for instructing recruits.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House.

E. G. Fleming,
Acting Adjutant and Company Commander.

Fatalities.—On Sunday last, at Eastbourne, a motor-car belonging to a visitor collided with and smashed one of the electricity supply H.T. switch pillars; two men who came to render assistance received fatal shocks, and several others had narrow escapes. The occupants of the car escaped injury, and, according to the *Times*, it is thought that the car was not actually touching any live metal, until it was moved by the men who came to help, when owing to the front axle coming into contact with a wire, the metal work of the car, which was rubber tired, became alive, and two of the men were killed. An inquest was opened on the 27th inst., and was adjourned in order that the Board of Trade might send down an expert.

An inquest has been held into the death of a driver in the A.S.C., who, during the gale on Monday, fell among some electric lighting wires used for lighting the Blackheath huts, which had been blown down, and received an electric shock. Verdict, "Accidental death."

Removing Iron Scale by Electrolysis.—When iron is worked into sheets, wires, tubes, &c., the well-known bluish-black scale is produced each time that it is heated to the annealing temperature, or in the case of tubes, to the welding temperature. This hard scale must be removed before the metal can be again rolled or drawn, or before it can be tinned or galvanised. This is usually done by immersing the oxidised metal in sulphuric acid, which is termed "pickling."

The black oxide of iron is Fe_3O_4, and this is not soluble in sulphuric acid. The scale is removed partly by dissolving the iron underneath it, and partly by forcing it off by generating hydrogen gas between the scale and the surface of the clean metal by the dissolving of the metal by the acid. The process is, therefore, intrinsically incorrect in principle, as it is not a true dissolving of the scale, but must consume good iron and a corresponding amount of acid.

In the electrolytic process, however, the action is reversed; the scale is rendered readily soluble and the metal insoluble, hence it is correct in principle, the scale alone being dissolved. In this process, first brought out by C. J. Reed, and patented by him, the iron is made the cathode, and the oxide dissolves readily; it is not reduced to metallic iron, but goes into solution as oxide. When the current density is high enough to keep the clean metal covered with hydrogen, no good metal will be dissolved. Hence the process is correct in principle; it will dissolve the scale only, will not dissolve any good metal, and will require the consumption of only as much acid as is necessary to dissolve the scale.

Although the amount of good metal and acid consumed in the ordinary pickling process, and saved by the electrolytic process, may be small relatively to the weight of the article pickled, yet when many tons of steel are cleaned per day, as in some large works, the value of these unnecessary wastes is considerable. Mr. Reed estimates that this saving would be about 50 to 75 cents per ton.

The anode in this process is most conveniently made of lead. The ordinary scale is removed in about a minute's treatment, less when thinner, and more when thicker. The cost of the electrical energy is very small, amounting to only a few cents per ton of wires and sheets. The iron comes out of the bath almost white, resembling silver, in marked contrast to the dirty gray appearance in the ordinary pickling process. It is then probably also in much better form for galvanising and tinning.—Carl Hering, in *Met. and Chem. Eng.*

Electric "Guard Wires."—In *l'Industrie Electrique* for December 25th an illustration is given of the electrically-charged wire fence erected by the Germans along the Dutch frontier to prevent desertions. The fence consists of several wires mounted on insulators and connected with a source of high-pressure current. Ordinary barbed-wire fences on either side prevent accidental contact with the electrified lines. The use of this system enables an effective barrier to be provided, and many sentries to be dispensed with, but of course the electric fence presents no difficulty to an electrician, and the Belgians are said to pass through the barrier with the greatest ease, with the aid of an ordinary barrel. Getting inside, the Belgian makes the barrel roll towards the electric fence by adopting the method of a squirrel in its cage; when the barrel reaches the fence, the iron hoops round it earth the wires, and the traveller, perfectly sheltered within his cage, passes under them without any risk or inconvenience.

Reserved Occupations.—A supplementary official list of reserved occupations includes:—

In all industries—Works Chemists.
Electricity Meter Manufacture—Calibrators.
Boiler Insurance Companies—Boiler inspectors, technical office staff.

Artificial Rubber.—According to German reports, Prof. Memmler, of the University of Berlin, has discovered a process for the manufacture of synthetic rubber, and a Frankfort firm of tire-makers has proved its practical value by exhaustive tests. The *Frankfurter Zeitung* opines that in the course of time "the manufacture of synthetic rubber will make it unnecessary to import rubber into Germany, and one of the gravest inconveniences caused by the stoppage of German oversea traffic will thus be removed; German science has made one more contribution towards winning the war."

For Sale.—Messrs. B. Norman & Son will sell by auction without reserve, at Westbourne Grove, W., on January 12th, a 60-H.P. gas engine, dynamo, switchboard, fittings, &c., of which some particulars are given in our advertisement pages to-day.

Appointments Vacant.—Shift engineers, station fitters, wiremen and engine drivers (steam and oil engine), for the Southern Command Military Camp, near Salisbury; two switchboard attendants for Wakefield Corporation. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—A Melbourne paper says that the chief engineer of the Tasmanian Government hydro-electric department has made the following appointments:—Power station superintendent, Mr. H. H. A. Curtis, of Lake Coleridge, New Zealand; shift engineer, Mr. B. S. Marshall, of Dunedin; Mr. P. S. M'Arthur, of Hobart; and Mr. G. F. Evans, of Balmain, Sydney.

Mr. R. Allan Brown has been appointed by the Falkirk Town Council electrical engineer for the burgh in place of Mr. Harold Ranson, who recently resigned with the object of joining H.M. Forces. Mr. Brown served his apprenticeship in Greenock, and afterwards held a position in connection with Glasgow Corporation tramways. He went to Falkirk five years ago as chief assistant engineer at the Corporation electricity works, and for the past three months has been acting as interim engineer.

The staff of the Bermondsey electricity works presented Mr. W. Tancred with a handsome clock as a parting gift on his leaving Bermondsey to take up his appointment at the power station, Stalybridge.

General.—Mr. Cecil Sainsbury, managing director of Messrs. Stothert & Pitt, Ltd., of Bath, who is to be married on January 1st to Miss Lois Alder, has been presented by the working staff with a silver card tray, and by the employés with a silver salver, silver rose bowl, and a silver match-box.

Eastern Engineering states that Mr. Arthur H. Preece (Messrs. Preece, Cardew, Snell & Rider, of London) recently arrived in Shanghai. He stopped at Hong-Kong, where his firm are consulting engineers to the Colonial Government and to the Hong-Kong Electricity Supply Co., and honorary consulting engineers to Hong-Kong University. Mr. Preece was to

remain in Shanghai about a fortnight. He went to Shanghai in response to the request of the Shanghai Municipal Council that his firm send out a man "to advise the Electricity Committee and Council generally on all points connected with the electricity extension undertaking." He was the principal guest at the first annual dinner of the Hong-Kong University Engineering Society, held on December 5th. Prof. C. A. Middleton Smith, who presided, remarked that China was the Mecca of engineering.

Roll of Honour.—Rifleman ERNEST ABBOTT, of the 12th Battalion Rifle Brigade, lately on the Rugby staff of the British Thomson-Houston Co., Ltd., has been killed in France.

Bombardier JAMES BURKE, of the Royal Field Artillery, formerly an electrician employed by Mr. R. Varley, of Colne, has been wounded in France, and is now in hospital at Boulogne.

We regret to learn of the death, at the age of 31 years, of Second-Lieutenant W. O. GARRETT, who had been for some years in the service of Messrs. Siemens Bros. Dynamo Works, Ltd., at Madras. Mr. Garrett left Madras in October, 1914, having obtained a commission in the Queen's Own 3rd Sappers and Miners, and after a short training in Bangalore he left for the front in Mesopotamia, whence he is now reported to have been "killed in action."

The death is reported in action of M. GEORGES MEYER, for some time secretary of the Chambre Syndicale des Industries Electriques, and chairman of the seventh section of the same.

Private FRANK WHITAKER, of the West Yorkshire Regiment, who went to the Dardanelles on July 3rd, has been missing from his regiment for some time. He is 38 years of age, and had fought in Egypt, being present at the battle of Khartoum. Prior to the outbreak of the present war he was engaged with the Yorkshire Electric Power Co.

News has been received of the death, as a result of wounds received in the battle of Loos, of Sergeant J. DALTON, of the West Cheshire Regiment. Sergeant Dalton had seen service in India and South Africa, and had been with the Forces since August, 1914. He was wounded during the retreat from Mons and was invalided home, but returned to the firing line again. Prior to the war he had, for six years, been engaged with the Phœnix Dynamo Manufacturing Co., of Bradford.

Private CLIFFORD BENTLEY, of the 12th Battalion Yorkshire Regiment, has died as a result of wounds received in action in France on September 30th. He was formerly engaged at the Heckmondwike electricity works.

Lance-Corporal ERNEST LAKEY, of the 9th Battalion West Riding Regiment, has been killed whilst on patrol duty in France. He was 21 years of age, and was formerly employed at the Halifax Corporation electricity works.

Obituary.—MR. A. T. WEBB.—The death occurred on December 21st, after an illness of ten months' duration, of Mr. Alfred Thos. Webb, who for about 20 years had been on the staff of Messrs. Crompton & Co., electrical engineers, of Chelmsford. He was 55 years of age.

HERBERT ARNAUD TAYLOR.—We learn with very deep regret of the death of Mr. Herbert Taylor, of the firm of Clark, Forde and Taylor, which occurred early on Thursday morning, the 23rd inst. Mr. Taylor was seventy-four years of age, and had been in failing health for some time past. Herbert Taylor obtained his commission as Lieutenant in the Royal Engineers (in June, 1862) when nearly 21 years of age. Ordered abroad at a time when, for urgent private reasons, it was necessary to stay in England, he resigned his commission and became a pupil of the late Mr. Latimer Clark, F.R.S., in 1867. This marked the introduction to telegraph and submarine cable engineering to which his whole life was devoted. Mr. Taylor, up to the time of his demise, was a partner in the firm of Clark, Forde & Taylor, the termination of his partnership occurring at his own request at the end of the present year. During Mr. Taylor's pupilage, and whilst acting for Mr. Clark as his chief assistant engineer, a large amount of useful work was carried out by him, notably in connection with the series of experiments which resulted in the production of the well-known Clark's Standard Cell and the determination of its E.M.F. in absolute measure, etc. In this work Dr. Alexander Muirhead was also associated. We may also mention the experimental work on the effect of temperature on the electrical resistance of gutta-percha covered conductors, which was carried out by Mr. Taylor on behalf of Mr. Clark. The first important cable work upon which he was engaged was the Persian Gulf cable of 1868, Latimer Clark being the engineer appointed by the Government to carry out the laying operations. On the voyage out to Bombay, on the P. & O. steamer *Carnatic*, the ship struck the Shadwan Reef in the Red Sea, many lives being lost. Mr. Taylor happily escaped by swimming to the Reef, on which some days were spent before relief came. The greatest trouble to Mr. Herbert Taylor was the loss of the whole of the testing instruments, but he, with improvised apparatus, sought for and constructed by himself, made the loss sufficiently good to insure the proper testing and control of the electrical part of the work during the laying of the cable. In 1892 Herbert Taylor became a partner with Latimer Clark, H. C. Forde and Charles Hockin, thus forming the firm known as Clark, Forde & Taylor, who, during the past 40 years, have acted as consulting engineers to all the great submarine cable companies, and whose name is intimately associated with the development and progress of submarine telegraphy. Beginning with the laying of the 1873 and 1874 Anglo-Atlantic cables, and in the succeeding years, Herbert Taylor acted as engineer on expeditions too numerous to record, including many of the lines of the Eastern Group. Indeed, tens of thousands of miles of cable were laid in all parts of the world under his personal supervision. The last foreign work undertaken by him was in connection with the laying of the British Pacific cable, upon which project he gave evidence before the Committee appointed to report upon the proposal, and for which subsequently his firm were appointed engineers, and as senior partner Herbert Taylor was responsible for the specifications to which the cable was manufactured and laid. Beyond taking part in his firm's engineering work, Mr. Taylor, in association with the Muirhead brothers, solved the problem of duplex working on submarine cables, and thus doubled the earning power of many millions of capital invested in such undertakings. The introduction of automatic transmission of signals on cable circuits was also in no small degree due to his efforts. The construction of highly sensitive relays was engaging Mr. Taylor's attention when, in 1898, Mr. S. G. Brown approached him in order to obtain his assistance in developing certain ideas relative to cable working, and this partnership resulted in the invention of the drum cable relay and magnetic shunt, which have proved of such great benefit to the numerous cable companies which have adopted the system. Such a record impresses upon us the services rendered to telegraphy by Herbert Taylor, whose many patents bearing on cable enterprise are evidence of his activities. Mr. Taylor was a member of the Institutions of Civil Engineers and Electrical Engineers, and served on the council of the latter for some years. As a member of the Sub-Committee on Cables, appointed by the Engineering Standards Committee, Herbert Taylor, with his exceptional knowledge of copper conductors, assisted materially in their deliberations. Unfortunately Mr. Taylor's natural reserve and dislike of publicity led to a large amount of interesting experimental work done by him not being published. We mention, however, papers on the "The Electromotive Force of Mercury Alloys," Hockin & Taylor; "Temperature Coefficients of Conductivity Copper" (C. F. & T.), which latter have been adopted by the Engineering Standards Committee. Those who knew Mr. Taylor admired him for his personal gifts and ever courteous manner. A staunch friend, and modest to a degree, he never had what is called the "business instinct." Disinterested and ready to assist any and all who came to him for help and advice on whatever matter it might be, assistance was rendered with a graciousness that left him no enemies but many friends, who will sincerely feel their loss in the death of this loyal gentleman, to whom meanness of thought or idea was absolutely foreign and unknown. Mr. Taylor was well-known to one of the Editors of this journal, and to a number of our readers, who, we believe, will desire to join with us in tendering sympathy with the family in their bereavement.

NEW COMPANIES REGISTERED.

Electrical Manufacturers' Co. of Great Britain, Ltd. (142,475).—Registered December 21st, by Lindo & Co., 2-3, West Street, Finsbury Circus, E.C. Capital, £12,000 in £1 shares. Objects: To carry on in Russia or elsewhere the business of commission, commercial, and general agents, contractors, merchants, bankers, engineers, ironfounders, shipowners, carriers, importers, exporters, buyers, sellers, and manufacturers of and dealers in machinery, implements, rolling stock, and hardware of all kinds, and to adopt an agreement between Bruce Peebles & Co., Ltd., Crompton and Co., Ltd., the Lancashire Dynamo & Motor Co., Ltd., Allen, West & Co., Ltd., Brook, Hirst & Co., Ltd., Eckstein, Heap & Co., Ltd., Whipp & Bourne, Ltd., and this company. The signatories (with one share each) are: E. H. F. Reeves, 381, Salisbury House, London Wall, E.C., company director; H. C. Siddeley, 28, Victoria Street, S.W., electrical engineer. Private company. The first directors (to number not less than two or more than ten) are J. H. Bunting, E. H. F. Reeves, H. C. Siddeley, W. J. Moggridge, J. A. Hirst, A. Eckstein, and S. Whipp. The said first directors are the respective nominees of the firms above named, and each may retain office during the pleasure of the firm nominating him. No qualification required. Registered office: 28, Victoria Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

W. A. Creedon and Co., Ltd.—Debenture, dated December 2nd, 1915, to secure £200, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: I. Staal, 13, Brownlow Street, High Holborn, W.C.

Ardee Electric Co., Ltd.—Particulars of £2,000 debentures, created July 28th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, and to Order of Court, dated December 13th, 1915, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Telephone Co. of Egypt, Ltd.—A memorandum of satisfaction to the extent of £200 on December 15th, 1915, of debenture stock covered by trust deed dated July 27th, 1904, and three supplemental deeds of acknowledgment dated February 21st, 1906, March 4th, 1908, and October 27th, 1909, securing £200,000, has been filed.

Oriental Telephone and Electric Co., Ltd.—A memorandum of satisfaction to the extent of £830 on December 15th, 1915, of debenture stock covered by trust deed dated June 28th, 1905, and supplemental deed of acknowledgment dated June 12th, 1907, securing £200,000, has been filed.

Albert A. Ball and Co., Ltd.—Debenture, dated December 16th, 1915, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). Holder: A. A. Ball, 92, Hornsey Lane, N.

CITY NOTES.

Melbourne Electric Supply Co., Ltd.

Mr. J. B. Braithwaite presided over the annual meeting, held at Finsbury Pavement House, E.C., on December 22nd. He said the only item on the debit side of the balance sheet which showed any change was the increase in the amount of consolidated ordinary stock from £300,000 to £375,000. The debenture issues were the same except that, of course, they had redeemed a further amount under the sinking fund. The dividend equalisation account of £10,000, established last year, remained intact. The balance carried to the profit and loss account was £64,777, which was much larger than last year. To deal first with the figures of the Melbourne undertaking, the income from private lighting was £94,791, against £81,778; from power, heating, etc., £44,393, against £37,466; from public lighting, £8,311, against £7,017; and from the supply to the municipal tramways, £21,443, against £16,836. The next item, that of bulk supply, £2,529, was exceedingly gratifying. Last year he told them they had commenced a bulk supply to one of the outlying municipalities of Melbourne, from which, at that time, they got the insignificant revenue of £321, but he pointed out the importance of that fact. Now they were supplying five of these outlying municipalities, so that it looked as if they had permanently put a stop to the idea of everyone putting down a little power-house of his own. Of course, the company supplied these municipalities on extremely reasonable terms—cheaper than they would be able to get a supply from a power-house of their own—but it consolidated their position and gave them an additional load. This year they had received eight times as much from that source as last year, and it was an item which was going to increase largely in the future. Meter rents, £8,084, showed an increase due to the increase in the number of customers, and the total revenue of the undertaking was £179,752, against £149,959, or an increase of about £30,000, which, in view of the war, the reduction made in price to consumers, and the drought from which the colony had only recently recovered, must be considered very satisfactory. On the other side, the generation of electricity had gone up from £27,125 to £35,072, the distribution of electricity from £1,695 to £1,794, repairs and renewals from £9,913 to £11,142, carbons, lamp renewals, etc., from £4,773 to £5,273, and general charges from £13,929 to £19,013. In connection with the latter item, he might say that 89 of their employés, or 17 per cent. of the total, had enlisted, and the company was paying the difference between the army pay and the wages they had been receiving to their dependents. Strictly speaking, he supposed this, and the subscriptions they had made to various funds, were a little outside the province of the company, but they were all members of the British Empire, and in this great war for the peace of Europe, he was sure the board would have the support of the shareholders in what they had done. As the result of the working of the Melbourne undertaking, they had carried £107,514 to profit and loss, as against £93,202. Geelong was a much smaller concern, and the revenue was slightly down, being £28,917 against £29,161. Geelong had felt the effect of the drought more than Melbourne, and, being a shipping port, had been affected by the war owing to the commandeering of ships and so on. The hay compressing industry had been interfered with, and as the compressors were worked by electric power the company had suffered. The balance carried to profit and loss was £10,161 against £11,137, which, under the circumstances, he thought was a good result. Coming back to Melbourne, he might say they had got the current available now in 537 miles of mains, and the expenditure which had been made in past years in the carrying of mains to the outlying districts was beginning to produce a harvest. Mr. F. W. Clements, their local managing director and chief engineer, had sent a report which showed the wisdom of the expenditure they had made in past years. He said they would never be able to say they had no distribution work to carry on, but that in the future it would be of much smaller dimensions than in the past. Out of 445 houses connected in one month, only 16 per cent. required pole extensions, and the company were about to reap the benefit of the capital expenditure of the past. There was the further satisfactory feature that they were not wholly dependent on new houses for their progress, as many of the applications were from old houses which were throwing out gas. Mr. Clements also said that they were justified in saying that money expended ten or fifteen years ago on overhead distributing mains was rapidly being rendered more profitable, and the increased profit was certain to be at a greater rate than the increase in capital expenditure. Another interesting feature was the success which had been achieved by the staff in the introduction of electricity for general domestic purposes. For instance, in the little matter of electric irons, they had over 5,000 installed in Melbourne, representing about 3,000 kw. of connections. They had also got a good load of radiators and other kinds of domestic appliances. With regard to Melbourne, there was a great deal on which they could congratulate themselves. As he had said, they were supplying five outlying authorities, and one was 18 miles from the power house. The traction supply was also increasing by the extension of the municipal tramways. In spite of the war and the drought, they had had over 4,000 additional consumers connected up, which was twice as many as any London company he knew of. The policy they had adopted of scrapping old plant and putting in the most efficient and latest type of machinery which could be obtained was steadily bearing fruit. Their proportion of profit was steadily increasing, and alongside of this they always had been and were considering the interests of the consumers, and they had reduced their rates for lighting and made further reductions in the power and heating rates, with the result that power could now be obtained by large consumers as low as .65d. per unit. So although their company was now in a very prosperous condition, its prosperity was not due to any mulcting of the consumers, but, on the contrary, they had always considered their interests and reduced rates wherever practicable. The true policy was to put in the most efficient plant possible, and make the whole system as efficient as they possibly could, and that enabled them to supply at a price which made it attractive. They were supplying a considerable amount of power to works making ammunition, and it was largely on that account that they obtained the Treasury consent to the issue of new capital in Australia. The Treasury would not give their sanction to the issue of the English portion at present, and as the issue of new capital at par represented a distinct bonus to their shareholders, they felt that the only course they could adopt towards their English shareholders was to give them certificates of rights which would entitle them to their portion of the shares at par as soon as the Treasury would permit the issue. The certificates were negotiable in the market, and they could sell their shares *ex* these rights. The result of the year's working was that, after paying the usual 10 per cent. and writing off the sum necessary to keep their station in an efficient state, and providing for sinking fund, etc., they proposed to carry forward over £40,000, as against £7,000 brought in. Shareholders might think that was a large amount to lay by, and undoubtedly it was; but, in all the circumstances, the board thought it the proper thing to do. They did not know what was before them. They did not know when the war was going to end, and they thought it wise to maintain their 10 per cent. dividend and keep their reserves absolutely liquid. He would, however, point out to the shareholders the security this gave them as to their dividend, for the £40,777 carried forward represented the full 10 per cent. dividend for the current year, which put them in a very strong position. In conclusion, the chairman dealt with the zeal and loyalty displayed by the staff in Australia, to whom, he said, the success of the company was very largely due.

Mr. David Finlayson seconded the motion.

Mr. H. R. Hawes pointed out that the auditors reported that nothing had been put to depreciation.

The Chairman explained that this was one of the little fads auditors had. They did not regard anything as depreciation unless it was called so in the balance sheet. They had written off £16,740 and had a general reserve of £70,000, and had carried forward £40,000; but auditors did not look on this as depreciation.

The motion was carried.

A vote of thanks was given to the local board in Melbourne.

British Columbia Electric Railway Co., Ltd.

The directors report that, owing to adverse circumstances, the result of the operations during the year ended June 30th, 1915, is exceedingly unsatisfactory. The period in question has been one of continuous difficulty and anxiety to the directors and the management in British Columbia. The following charges have been made against the revenue account for the year:—Provision for renewals maintenance £167,888, addition to capital amortisation fund £2,554, provision for income-tax £10,000 = £180,442. The net revenue, after making these deductions, amounts to £180,661, plus £6,884 brought forward and £60,000 transferred from reserve fund, making £247,546. Deducting interest on debentures and debenture stock to June 30th, 1915, £132,879, and dividends already paid on 5 per cent. cum. perp. pref. stock for the year, £72,000, and on preferred ordinary stock for the year at 2½ per cent. per annum, £36,000, there is a balance of £6,667 to carry forward. In order to make the above dividend payments it has been necessary to transfer £60,000 from the reserve fund.

Owing to the war, and especially to the resultant paralysis of the shipping trade, commercial depression of the most acute severity has prevailed throughout British Columbia, which has brought about an almost complete cessation of expenditure by the Government, municipalities, railways, and other large undertakings. This depression has been responsible for a decrease in population, estimated at about 30 per cent., in the districts served by the company. The spending power of the remaining population has been reduced, and a general tendency to economise has resulted.

As one result of the depression, a very serious difficulty arose at the beginning of 1915, when the company had to meet an extraordinary form of competition from privately owned motor cars which started plying for hire at ordinary tram fares in opposition to the company's cars. The directors have already issued circulars to the stockholders drawing their attention to the fact that these motor cars, which are called "Jitneys," are allowed by the authorities to compete with the company on a very unfair basis.

To meet this jitney competition the company, some months ago, reduced some of its fares as an experiment. The results of this experiment have been disappointing, and other measures are being adopted to cope with the situation. It has been proved that cities of the size of those served by the company cannot support a thoroughly efficient and convenient electric railway service and also an unrestricted service of jitneys. At the present time the tramway service is run to a regular schedule. It serves all districts, including outlying ones, at all hours, regardless of whether such service is profitable or not. The inhabitants will, therefore, have to choose whether they will retain the present tramway service, or whether they prefer the unregulated

service of jitneys, coupled with a very much curtailed service by the tramways, which would necessarily be restricted to the actual requirements of present business and would also be restricted to routes and districts which were profitable to operate.

The depression and jitney competition combined have rendered it impossible for the company, notwithstanding the most rigid economy, to operate the street railway system at a profit. In order to meet the new conditions, the most determined efforts have been made by the board and management to curtail expenditure in every direction. The general manager has reduced and carefully reorganised the staff in British Columbia. Operating and all other expenses of the company have been drastically reduced, but the full effect of these economies is not apparent from the accounts now submitted. On June 30th, 1915, the wages agreement between the company and its employés terminated, and the Board of Arbitration made an award, reducing the rates of wages paid to the employés by about 8½ per cent., which will represent a saving of about £22,000 per annum. The general manager estimates that the various economies put into force during the current year, together with the reduction in wages, will amount to a reduction in expenditure, as compared with the year ended June 30th, 1914, of very nearly £200,000, and he states that this will be accomplished without in any way affecting the efficiency or general upkeep of the plant or the public safety. Unfortunately against this economy there is a decrease in gross earnings during the first four months of the current year of £124,147. For the purpose of comparison, it must be borne in mind that during the corresponding four months of last year the Jitneys had not commenced to compete and the full effect of the war had not been felt. In reviewing the work which has been accomplished during the year, the general manager reports that the company's plant has never been in a higher state of efficiency, and the company is in an excellent position to profit by an improvement in business conditions when the war is over. £167,888 has been set aside out of earnings for renewals maintenance. This charge is calculated upon a fixed basis settled some years ago, to which the board have determined to adhere. The charge is a heavy one to provide in times like the present, but provisions of this character make for a sound financial status. The expenditure on capital account during the past year by the company and its subsidiaries has been 875,558 dols., which compares with 4,110,327 dols. for the previous year. Practically the whole of this expenditure relates to works authorised and entered into some time prior to June 30th, 1914. In considering capital expenditure, it is necessary to remember that the population of newly-developed countries fluctuates to a considerable extent, and that such countries are susceptible to the extremes of prosperity and depression. It is, therefore, impossible for a public utility company always to provide the plant and equipment that is precisely adequate to the requirements of the moment. The company will probably have for some time a general equipment considerably in excess of immediate needs, and it may have to face a delay of some years in the development which would, but for the war, have taken place in the province. At the same time, the company is now undoubtedly in a very strong position to take advantage of the revival in business when it extends from the eastern part of Canada to the western coast. Without in any way minimising the difficulties which will have to be met in the next few years, the directors feel that they can congratulate themselves and the stockholders upon the strong financial position in which the company stands. As will be seen from the accounts, the company had on June 30th the following liquid assets, viz.:—Marketable securities (at cost) £105,000, short loans and cash in hand £418,876= £523,876. Since that date the liquid resources of the company have increased. Although there is no immediate prospect of sufficient profits being earned to pay the dividend on the 5 per cent. cumulative perpetual preference stock, the directors are of opinion that the company's financial position justifies the payment of the dividend for the current year out of the reserve fund, and a resolution will be submitted to the stockholders to approve of this course being adopted. The directors are unable to hold out any hope that they will be able to recommend the payment of any dividend on the preferred ordinary or deferred ordinary stocks for the current year. When the last War Loan was issued the directors, in view of the large liquid resources, subscribed for £100,000 thereof, which has been paid up in full, and is now held by the company as part of its liquid assets. In considering the situation the directors realise the severe disappointment of the stockholders at the present results and the hardship imposed on many of them, but they wish to warn them against undue pessimism. The directors remind the stockholders that a young country in the geographical situation of British Columbia feels the effect of the war far more acutely than an old country like England, and, on the other hand, British Columbia, with its magnificent and scarcely developed natural resources, should recover far more rapidly than older countries. In his last report, the general manager says:—"All we ask is reasonable time in which to readjust the business to changed conditions, requiring patience on the part of the proprietors."

Year ended June.	Income after charging renewals maintenance.	Passengers.	Lamps in use.	Balance available for dividend.	Pref. ord. stock, div.	Def. ord. stock, div.	Taken to reserves.
1913 ..	£401,896	71,978,822	930 916	£256,249	6 %	8 %	£196,911
1914 ..	410,229	61,429,023	971 628	260,985	6 %	8 %	144,920
1915 ..	201,768	46,880,096	1,012,780	47,782	2½%	—	71,493

The annual meeting was held yesterday in London.

Allgemeine Elektrizitats Gesellschaft.

THE annual meeting of the A.E.G. was held recently in Berlin, under the presidency of Dr. Walter Rathenau, who stated that the shareholders would understand that under present conditions the directors had imposed limitations on the length and contents of the report, as the company was one which was most attentively followed both at home and abroad, and the desire that they should offer no occasion for discussion which was not in the company's interests was comprehensible. A similar observation also applied to the account of investments, which was not particularised for the past year because it contained many securities of companies which were in operation in other countries. The question had been raised in the newspapers as to whether the profits realised in 1914-15 had arisen solely from manufacturing, or whether they also comprised profits on financial operations. The directors had refrained on this occasion from emphasising that the profits did not include those of a financial character, quite apart from the circumstance that those of the latter class were scarcely possible in the past year. Beyond this, the speaker added that the so-called war profits only amounted to a very insignificant sum, although the company had placed its plant to a large extent at disposal for the defence of the country; but this had not been done for the purpose of obtaining large profits. The increase in the dividend by 1 per cent. to 11 per cent. was supported by the confidence in the political situation, the progressive feats of arms of the allied armies, and the honourable conclusion for Germany of peace in the near future.

The Chairman proceeded to refer to the relations between the A.E.G. and the Berlin Electricity Works Co. during the past thirty years, and stated that as a result of the discussion at the recent meeting of the latter, and after further consideration, it had been decided to abstain from prolonging the agreement. The interests of the manufacturing firm would be sufficiently preserved by two of the oldest directors assuming seats on the board of management of the B.E.W. During the first three months of the new financial year the value of the turnover amounted to £4,500,000, as compared with £4,350,000 in the corresponding period of 1914, whilst the value of the orders on hand reached £16,700,000, as contrasted with £16,150,000 a year ago. The credit at the bankers had experienced a moderate advance since the conclusion of the financial year.

The question of monopoly contracts also occupied attention. The Chairman stated that the company had been the first to break with the system of such contracts, which concerned those which were concluded with municipal and other local authorities for the sole right of delivering installation materials. The company had recognised at an early date that that principle was not only incorrect, but also that it was undesirable. If subsidiary companies of the A.E.G., of the third or fourth rank, had here and there entered into negotiations aiming at a monopoly in the supply of materials, that did not represent the wish of the parent company. In the case of the Berlin Electricity Works, a so-called monopoly agreement had not existed; it was, rather, more properly designated as most favoured treatment. As long as the B.E.W. continued to supply Berlin the agreement was of importance to the A.E.G., but as the former company had ceased to be the supply authority, the most favoured treatment agreement was no longer of value to the latter. The shareholders, therefore, need not deceive themselves because the A.E.G. no longer had to expect large orders from the B.E.W. That was not any great misfortune for the company, as the orders received from the supply company had only represented 1.4 per cent. of the total orders booked.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

THE annual meeting was held on December 22nd at the offices, 106, Cannon Street, E.C., Major LEONARD DARWIN in the chair. The CHAIRMAN, after referring to the absence of Col. W. Jarvis, a director, who was away on military duties, said that at the meeting a year ago they had a very unsatisfactory report to make, but, in spite of the loss sustained, he ventured to express a hope that their main troubles were things of the past. This hope, he was glad to say, had been justified by the year's working. Owing to war conditions, both their factories at Silvertown and at Persan had been occupied with Government work, whilst they had been able to execute a portion of their ordinary work without interfering with the Government demands, which, of course, had had first call on their resources. This fact had on the whole increased their yearly turnover to a considerable extent, and although the Government orders did not in themselves carry as large a profit as their ordinary business, yet the increased turnover had automatically decreased the percentage of standing charges, and thereby increased their profit. During the year they had had to meet many difficulties in the ever-changing costs of labour, material, transit and fuel, and he was glad to think that their anticipation and action in the past with those unknown factors before them had been justified by the final results of the year's trading. With reference to the foreign branches, they had nearly all shown a distinct improvement on the past year's records. This im-

provement had been partly due to more economical methods being adopted, and also, to some extent, to an increase in the volume of the business due indirectly to the effects of the war. Their factory at Persan had done very well this year, having transformed what had been a loss for some years into a profit. This change had been due to a great extent to an improvement in the methods of buying, manufacturing, and selling the goods, and a more accurate knowledge of the costs of production. Their ship *Dacia* had been employed on important work which, he was glad to tell them, she had succeeded in completing in a most satisfactory manner. With reference to the future, he would not venture to prophesy, as it was extremely difficult, if not impossible, for anyone to accurately foretell the effects of this war on trade in general and their own in particular. As long as the war continued they hoped they would be able to fill their works and keep all the available labour employed, especially on Government requirements; but when the war finished and there was a falling off in the demand for war supplies, it would be necessary to some extent to rebuild that portion of the business which they had been unable to maintain owing to the war conditions. In addition to the above-mentioned method of dealing with such part of their ordinary business as had suffered from the war, it had been the aim of the directors, amongst other things, to be prepared to produce in their factories such work as had hitherto been produced in Germany and supplied to England and France, in order that when the munitions of war were no longer required they would be in a position to compete with the German suppliers in those markets. They anticipated that there would be difficulty in doing this, but, on the whole, they hoped to be able to maintain a satisfactory condition of profit. In the early part of the coming year they would have to deal with the question of the redemption or renewal of the debenture bonds, which at this most unfavourable time would doubtless mean an increased rate of interest in the future. The subject was receiving their closest attention, as it was one which required careful handling in the interest of all concerned. There were many problems of the future which had to be studied and decided upon when the war was finished, but their difficulties in this respect were the same as those of their competitors. They therefore looked forward to the future with the belief that their organisation and methods would enable them to successfully deal with those unknown conditions, and he thought the company would maintain its old record in the possibly altered circumstances arising out of the war.

Mr. C. B. Gray seconded the motion.

In reply to questions, the Chairman said it was true that they had to go to the bank to help them pay the last interim dividend. Since then their affairs had prospered, with the result that the cash in their possession was considerably larger, and they had been able to pay off the bank loan. With reference to their telegraph ships paying, of course there had been some years when probably they had not made a profit, but on the whole he should say they had paid. They believed there would always be a future for cable work, and they looked forward fairly confidently to be able to do good work in that direction. At present they only had two ships, as compared with three a year or so ago, and it was just possible they might only keep one. They did believe, however, that there was a future for cable work before them, and, as he had told them, one of their ships had just been doing an important piece of work in connection with the war, which would give them a certain amount of profit and a very considerable amount of credit.

Mr. Gray also replied to some questions with reference to the number of the company's employés who had enlisted. Speaking from memory, he said the number was somewhere in the neighbourhood of 450. They were allowing all such half-pay, a course of action which he was sure would meet with the approval of the shareholders. The number of women employed in the factories was between 450 and 500. He found they were doing their work fairly satisfactorily, but, of course, the labour question was a troublesome one throughout the whole country.

The report was adopted.

The Siemens & Schuckert Group of Companies.

The Nuremberg Concern.

The accounts of the Elektrizitats A.G. vorm. Schuckert and Co., of Nuremberg, shows gross profits of £436,000 for the year ended with July 31st, 1915, as compared with £412,000 in the previous twelve months. After defraying general expenses, interest charges, taxes, etc., amounting to £182,000, as against £166,000, and placing £5,000 to the coupon tax and reserve funds, as in 1913-14, the net profits and balance brought forward are returned at £315,000, as contrasted with £304,000. It is proposed to pay a dividend of 6½ per cent. on the ordinary share capital of £3,500,000, this being the same rate as in 1913-14, and to carry to the new year the balance of £76,000, as compared with £66,000 in the preceding year.

The Rhenish Schuckert Co.

The report of the Rheinische Schuckert Ges. für Elektrische Industrie, of Mannheim, which deals with the year ended with July 31st, 1915, states that constructional and installation work had to be restricted immediately on the outbreak of the war owing to the calling-up of employés and the scarcity of various materials. As the conditions did not improve in the further course of the year, the company was compelled to close most of the constructional department and to postpone the execution of the extensive works on order. The nature of the undertaking precluded the company from participating in Army contracts. Considerable difficulties also existed in connection with the company's supply works and associated undertakings. The scarcity of petroleum certainly caused an exceptional number of applications for house connections to be made by small consumers, but these could not be fully complied with for the reasons given. It was, therefore, not possible in all cases to equalise the decline in the delivery of power which was due to the war by an increased consumption for lighting purposes. Under these circumstances, the working results for a year would be regarded as comparatively satisfactory. The gross profits from undertakings, investments, etc., amounted to £107,000, as contrasted with £140,000. After meeting general expenses, interest on loans and mortgages, and setting aside £12,000 for depreciation and reserve funds, as against £14,000, and £13,000 for war allowances, the accounts indicate net profits and balance forward of £45,000, as compared with £56,000. It is intended to distribute 5 per cent. on ordinary share capital of £550,000, being the same rate as in 1913-14.

Siemens and Halske.

The directors of Siemens & Halske, A.G., of Berlin, reporting on the year which closed on July 31st, 1915, observes that the statements made in the report for the previous year on the situation of the undertaking had also proved to be correct during the past year and down to the present time, and no change in the conditions had taken place which could influence the confidence which was expressed at that time. The displacement in the activity of the individual manufacturing departments which was proceeded with a year ago had been continued. The war had caused considerable demand for the provision of electrical auxiliaries of manifold kinds, either directly for the equipment of the Army and Navy, or indirectly for delivery to other undertakings which were working on war material. In addition to a substantially greater production of the types of manufactures which were already furnished for these purposes in times of peace, many new problems had to be solved, and by this means and the utilisation of still available plant for other war requirements, compensation had been obtained for the decline in the actual peace orders, both from the Government authorities and private customers. The working results, consequently, corresponded in general to those of former years, and it was possible to revert to the dividend rate of 12 per cent. The directors believed that they must make special provision this year for impending problems of war allowances, and the sum of £150,000 had, therefore, been included for this object. The number of officials and workmen called from the company's works and those of the Siemens-Schuckert Works, was 27,736, and the numerous requisitions had rendered it necessary frequently to resort to female labour in the offices and workshops. A very large increase took place in the average weekly earnings of the workers as compared with times of peace. The accounts show the following figures:—

	1912-13.	1913-14.	1914-15.
Ordinary share capital ...	£3,150,000	£3,150,000	£3,150,000
Loans	2,242,000	2,216,000	2,194,000
Balance brought forward ...	63,000	60,000	60,000
Gross profits	733,000	661,000	884,000
General expenses	54,000	49,000	55,000
Interest on loans	95,000	94,000	93,000
Depreciation	21,000	20,000	19,000
Provision for war grants	—	—	150,000
Net profits	562,000	496,000	566,000
Special reserve fund ...	100,000	100,000	100,000
Contingency fund	25,000	25,000	25,000
Bonuses	45,000	45,000	45,000
Dividend	378,000	315,000	382,500
Dividend, per cent. ...	12	10	12
Carried forward	60,000	60,000	62,000

The balance sheet shows cash in hand and credit at the bankers amounting to £713,000, and investments for £229,000; the permanent investment account, including the Siemens-Schuckert Works and the Austrian, English, and Russian companies, stands at £4,426,000, as against £4,607,000 in 1913-14. The debts due, including profits from the Siemens-Schuckert Works, represent £2,301,000, as compared with £2,156,000, whereas debts owing are £1,425,000, as contrasted with £1,228,000 in 1913-14. The ordinary reserve fund remains without change at £675,000, whilst the special reserve fund with the present allocation rises to £650,000.

The Siemens-Schuckert Works.

The report for 1914-15 of the Siemens-Schuckert Works states that the war materially affected the course of business, as the company's markets extended to all the countries involved in and influenced by the contest, and as a consequence the distribution of the manufactures in the markets had become changed. The former extensive exports had for the greater part ceased, but the Army and the Navy had made large claims upon their capacity, and further requirements were called for through the effects of the war. As a result of the compensation thereby afforded, the directors were able

to resume the level of profit distribution which was departed from a year ago, and at the same time, having regard to the more favourable use made of the stocks on hand at the outbreak of the war, to make a special appropriation for the forthcoming problems of war provision, for which it was proposed to allocate the sum of £200,000. It was possible for the works duly to meet the multifarious requirements of the Army and Navy, and the demand for new electro-technical auxiliaries for the conduct of the war. In addition, abundant work was provided through the increasing activity of other branches of industry which served the purposes of the Army and Navy, particularly the chemical industry. Prominent in the latter direction was the equipment of the Imperial nitrogen works, which required transformer units of 30,000 KW. with 80,000 volts principal pressure, and weighing 70 tons, with oil insulation, which were the largest units hitherto constructed. An increase in the company's liquid funds was brought about through the hampered development of large new undertakings for the supply of electricity, the sale of a portion of the stocks, and the more rapid completion than in times of peace of the manufactures needed by the Army. Since the balance sheet was prepared, this liquidity had substantially increased, although the resumption of peace manufactures and a corresponding restoration of stocks would again lay claim to the funds now rendered available. The works took an active part in the discovery and employment of materials in substitution for the raw materials obtained from other countries in times of peace, and gratifying progress in these directions was achieved; but the development of manufactures for peace purposes naturally had to give precedence to war requirements. It was only possible by the engagement of new workers partly to equalise the deficiency caused by the call to the Colours of officials and workmen during the whole of the year, and a displacement took place in favour of female labour. Subscriptions to the Imperial war loans were made in the circles of the company, including their original houses, amounting to £250,000 of the first loan, £375,000 of the second, and £675,000 of the third, the last mentioned coming into the new financial year. The accounts present the undernoted figures for the past three years:—

	1912-13.	1913-14.	1914-15.
Capital	£4,500,000	£4,500,000	£4,500,000
Ordinary loans	3,805,000	3,877,000	3,847,000
Perpetual loans	2,500,000	2,500,000	2,500,000
Balance forward	15,000	17,000	12,000
Gross profits	1,167,000	1,063,000	1,399,000
General expenses	94,000	94,000	109,000
Interest charges	333,000	337,000	336,000
Depreciation	62,000	73,000	77,000
Net profits	676,000	557,000	876,000
Reserve Fund	125,000	125,000	125,000
Bonuses	75,000	75,000	75,000
Provident fund	25,000	25,000	25,000
War provident fund ...	—	—	200,000
Profit distribution	450,000	337,000	450,000
Profit distribution, per cent.	10	7½	10
Carried forward	17,000	12,000	13,000

The total sums owing to the company, including £2,350,000 on credit at the banks, amounted to £8,615,000, whereas the company's liabilities reached £3,085,000 at the end of the financial year.

Costa Rica Electric Light and Traction Co., Ltd.

Mr. W. F. Leese presided, on December 22nd, over the annual meeting, held at Dashwood House, E.C. He said that the result of the past year had not been so good as was that for 1914. The actual volume of business had been very nearly the same, and the profit would have been practically the same had the rate of exchange not fallen. The net earnings had amounted to £21,662, as against £26,351, a decrease of £4,689. The lighting department had been practically as good as in the previous year, and the cooking and heating department had shown up very much better. A great part of the electricity supply of Costa Rica in the future would be for those purposes, as there was no coal there, and wood was getting more and more scarce. Electricity was, fortunately, comparatively cheap, and as they obtained it from water power there was a constant supply. The tramway undertaking had not done so well, the reason being the poverty of the country generally. People must have light and they must cook, but when it came to a matter of travelling they economised by staying at home or walking. As to the future, he was glad to say there had been a fairly good coffee crop, which would benefit the country if it could be brought to Europe. The number of their customers for lighting had increased, but the number of lamps connected showed a small diminution. The number of power customers had also slightly increased, but there, again, the consumption had decreased a little. As he had said, for heating and cooking the demands were increasing rapidly. They had 360 such customers at the end of the year, as compared with 208 last year, and 60 two years ago—an increase of 300 per cent. in three years. The receipts also showed a satisfactory increase. The car mileage on the tramways last year was 459,353, as compared with 436,594 in the previous twelve months. The number of passengers carried was 1,892,000, as against 2,193,000, a decrease of 14 per cent.

Mr. F. M. Crisp seconded the motion, and the report was adopted.

Burmah Electric Tramways and Lighting Co., Ltd.

The annual meeting was held on December 23rd at the offices, Queen Victoria Street, E.C., Mr. D. C. Ellis presiding. The Chairman reminded the shareholders that the year under review practically coincided with the declaration of war, whilst it compared with a record year in the company's history. Having regard to those facts, he thought they would agree that the result of the trading might be considered satisfactory. The effects of the war conditions on the traffic receipts for the first four months of the year were seen at the last meeting. These drawbacks, coupled with considerable sickness and a heavy death rate from dysentery, cholera, and plague during the cold weather, and a complete absence of country folk during most of the year, caused a setback in the traffic which continued until May, when a gradual partial recovery took place. The result was a decrease in the receipts of £3,127. It was satisfactory to note the continued growth in revenue from lighting and power, the actual increase under this head amounting to £863. Whilst the number of new consumers was not quite so large as last year, the number of new lamps connected was the largest in the history of the company. Amongst other business, an agreement was entered into with the municipality for street lighting, which was commenced in February last with excellent results, the system having met with universal approval. The net result was an increase of £631 in the sundry receipts and a decrease of £2,581 in the total gross receipts. The total expenditure showed a decrease of £499, principally due to a reduction in cost of maintenance and repairs. The result was a trading profit of £6,662, plus £1,180 brought forward, giving a balance of £7,842. Out of this £2,000 had been carried to depreciation account, making it £18,394, leaving an available amount of £5,842, out of which it was proposed to pay a dividend on the preference shares of 5 per cent., absorbing £5,000, and to carry forward the balance of £842. It had been suggested that it would make the position of the arrears on the preference dividend clearer if the last two payments made and the one now proposed were allocated to the discharge of the first of such arrears, and the directors proposed to adopt this course. In regard to the prospects for the current year, the traffic receipts for the first quarter showed an increase of Rs.3,170. The manager reported that as the trade of Burmah still continued unsatisfactory, owing to the want of shipping facilities and capital, and as, in addition, there were the disturbing factors of the increase in the price of rice, the very high death-rate from cholera and the probability of a bad plague season, they must not count on any great improvement in the traffic returns over last year. On the other hand, it was satisfactory to report that the light and power business continued to go ahead. Incidentally, he might mention that they were now supplying current to a cinema hall, which had been started with great success, and which had brought them an order to supply a theatre, with the promise of a further hall. They were also commencing a temporary supply to the municipality for pumping purposes, and were considering a scheme for hiring out fans.

Major Henry R. Kindersley seconded the motion, which was adopted.

Humphrey Pump Co., Ltd.—The report states that the directors regret that the war still continues to seriously affect the business of the company. The company's claims in connection with the large pumping contract at Mex, Egypt, have not yet been finally settled. The principal patents have been maintained and defended and additional patents secured.—*Financier.*

Chili Telephone Co., Ltd.—The directors announce an interim dividend at the rate of 6 per cent. per annum, free of income-tax, for the past half-year.

STOCKS AND SHARES.

Tuesday Evening.

The Christmas holidays have naturally taken up most of the time and pre-occupation of the Stock Exchange. Upon the resumption of business to-day (Tuesday), there was a good tone prevailing in most of the markets; but business was scanty, and the Stock Exchange presented a placid appearance, with the exception of the market for rubber shares, where, for an hour or two, considerable animation ruled, and prices advanced substantially during the greater part of the day.

So far as the electric markets are concerned, trade is very quiet. Price alterations this week are few and far between;

and, in the circumstances, we make no apology for presenting our usual lists of stocks and shares showing the changes on the year. We have cut the lists shorter than usual, because, after all, the interest attaching to observation of the prices is tinged with melancholy, and it is not kind to remind proprietors of the depreciation which their investments have undergone by reason of the war. So we take but a few selections from each division.

The Stock Exchange re-opened on January 4th, after having been closed for five full months. Business on the first day of re-opening collected rather under 1,000 bargains, whereas at the present time the average is roughly 2,100 *per diem*, while in the spring-time the number ran up to nearly 4,000. If there is one feature of the financial year which stands out particularly, it is, of course, that of Government borrowing; while another, not less remarkable, is that frequently dwelt upon here—namely, that all the demand for capital should have had so comparatively mild an effect upon prices.

Coming to our figures, we will take the electricity supply companies first. The final dividends for last year were all good, but in the interim distributions in respect of the current twelvemonth there were hints of probable reductions in respect of 1915. The market is stagnant and subdued:—

Share.	July 30, 1914.	Dec. 31, 1914.	Now.	Fall.
Charing Cross	5⅛	5	3¼	1¾
City of London	16	15½	12½	3¼
Metropolitan	3⅝	3¼	2⅜	⅞
St. James's	9⅜	9	6¼	2¾

The Telegraph market has kept its end up with a good deal of strength, and some of the prices show rises since a year ago. This came about as the result of steady investment purchasing, coupled with the fact that the companies are mostly doing well—more particularly in the direction of reducing their expenses. This is a short list:—

Stock or Share.	July 30, 1914.	Dec. 31, 1914.	Now.	Rise or Fall.
Anglo-American pref. ...	108	103	100¾	−2¼
Anglo-American def.	22¾	21½	22⅞	+1⅜
Direct United States ...	6⅝	6¼	6¼	—
Eastern	130½	122	128	+6
Globe Telegraph and Trust	11½	10⅝	10⅜	−¼
Ditto pref.	12⅞	11¾	10⅜	−1⅜
Marconi	1 9-16	1⅛	1⅛	+¼
Western	13⅝	12¼	12⅝	+⅜

The Home Railway Market has suffered a good deal from neglect, and from the uncertainty involved in the Government's having taken over the railway business of the country. With no traffics to stimulate interest, and with the interim dividends last autumn on a scale that was slightly disappointing, there has been little or nothing to infuse revival into prices. A few spurts there have been, mostly very short-lived; and the depression is reflected in the price lists:—

Stock or Share.	July 30, 1914.	Dec. 31, 1914.	Now.	Fall.
Central London Ord. ...	80	76	72½	3½
Metropolitan	31½	31½	24½	7
Ditto District ...	19	18	15¾	2¼
Underground "A" ...	6/6	6/3	5/6	9d.
Ditto Ord. ...	2⅛	2	1⅝	⅜
Ditto Income ...	83	80	77	3

Mexican, Brazilian and Canadian securities have undergone remarkable developments, and not a few rapid changes during the year, the reasons for which are so thoroughly well known that it is superfluous to reiterate them. Brazilian Tractions, on balance, are 5 points down on the year, after having been higher, as well as lower. Mexicans enjoyed a little favour when it seemed likely that President Wilson would recognise Carranza; but this was not followed up by definite action, and so most of the prices have sagged back, although not quite so low as they were before. A few prices are appended, to which we add three or four of the home industrial group:—

Stock.	July 30, 1914.	Dec. 31, 1914.	Now.	Rise or Fall.
Anglo-Arg. Trams 1st pref. ...	4 13-16	4¾	4⅝	−⅛
Brazil Tractions	58	56¼	51⅛	−5
Mexican Light and Power ...	41½	32½	30	−2½
Rio Tram. 1st mort.	97	95	91¼	−3¾
Babcock & Wilcox	2⅞	2⅞	2⅞	—
Brit. Westinghouse pref. ...	1 11-16	1 15-16	1 15-16	—
Castner Kellner	2⅝	2¾	3	+¼

In the way of business, the market in manufacturing shares has "enjoyed" spasmodic activity—British Aluminium, for instance, and British Westinghouse preference, having been very prominent at various times. The rubber market is the best off in the Stock Exchange, both as regards orders and firmness of prices, which have been sustained by the strength of raw material and the promising outlook for the continuance of this condition; indeed, many people look for better prices still. And we may be permitted to express the devout hope that other markets will fulfil the same expectation in the period about to dawn, which determination, resolution and faith have already marked out as certain to prove a Happier New Year.

SHARE LIST OF ELECTRICAL COMPANIES

	Dividend, 1914.	Price Dec. 28, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	3½	—	7 2 10
do. do. do. 4½ Pref.	4½	3½	—	6 0 0
do. do. City Pref.	4½	3	—	7 10 0
do. 4 Deb.	4	73	—	5 2 7
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 3
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	83	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2⅜	—	7 7 4
do. 4½ per cent. Pref.	4½	3½	—	6 0 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6½	—	8 0 0
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2⅜	—	7 5 6
South Metropolitan Pref.	7	1 1/16	—	6 14 0
Westminster Ordinary	9	6½	—	6 18 6
do. 4½ Pref.	4½	4½	—	5 9 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	100⅜	+ ½	5 19 6
do. Def.	1½	22⅝	—	6 11 3
Chile Telephone	8	6½	—	6 3 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12½	—	*6 8 0
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	128	—	*6 4 0
do. 8% Pref.	8	66	—	6 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 12 2
do. Pref.	6	10⅜	—	5 15 8
Gt. Northern Tel.	22	83½	—	6 11 4
Indo-European	18	48 xd	—	6 15 4
Marconi	10	1⅞	—	5 6 8
New York Tel. 4½	4½	101	—	4 9 1
Oriental Telephone Ord.	10	1⅜	—	5 6 8
do. Pref.	6	⅜	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	6	—	*7 12 5
do. Pref.	5	4⅜	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅜	—	*6 7 0
do. 4 Deb.	4	80	—	5 0 0
Home Rails.				
Central London, Ord. Assented	4	72½	—	5 10 6
Metropolitan	12½	24½	—	5 2 0
do. District	Nil	15⅜	+ ½	Nil
Underground Electric Ordinary	Nil	1⅜	—	Nil
do. do. "A"	Nil	5/6	—	Nil
do. do. Income	6	77	—	*8 17 6
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95 xd	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4½	+ ⅛	6 15 0
do. 2nd Pref.	5½	3½	—	7 17 3
do. 4 Deb.	4	75	—	5 6 8
do. 4½ Deb.	4½	79	—	5 14 0
do. 5 Deb.	5	81	—	6 4 0
Brazil Tractions	5½	51	— ⅛	6 18 0
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	85	—	5 3 0
British Columbia Elec. Rly. Pfce.	5	60	—	8 6 8
do. do. Preferred	—	40	—	Nil
do. do. Deferred	—	40	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	42	—	Nil
do. 5 per cent. Bonds	—	49	—	Nil
do. 6 per cent. Bonds	—	48	—	Nil
Mexican Light Common	Nil	30	—	Nil
do. Pref.	Nil	42	—	Nil
do. 1st Bonds	—	47	+1	—
Manufacturing Companies.				
Babcock & Wilcox	14	9⅜	+ 1/16	5 18 0
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	5⅜	—	5 11 7
British Westinghouse Pref.	7½	88/6	—	7 16 0
do. 4 Deb.	4	69	—1	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	10½	—	7 2 10
do. 5 Pref.	5	4⅜	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	8	—	6 13 4
Edison & Swan, £8 pd.	Nil	9/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	63	—	6 9 1
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	92	—	6 3 1
Henley	20	18½	—	*8 12 6
do. 4½ Pref.	4½	4⅜	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9½	+ ½	*12 7 0
Telegraph Con.	20	51½	—	*8 1 0

*Allowance made for dividends being paid free of income-tax.

Patents and Alien Enemies.—Application has been made to the Board of Trade for a licence in respect of Patent No. 15,128/11, granted to Siemens & Halske A.-G., for manganese peroxide anodes, by the Refractory Zinc Ore Treatment Co.

CONTROL GEAR FOR ELECTRIC LIFTS.

By ARTHUR L. HAWES.

The switchgear employed for the control of electrically-driven lifts is equally as important as the driving mechanism, although by some it receives very secondary consideration, so much so that often very unsatisfactory control gear is installed, resulting in endless trouble.

As the success or otherwise of an electric lift depends to a large extent on the control gear, no doubt a brief description of modern types, together with various methods of control, will be of interest.

A successful controller must operate the lift under all conditions of loading smoothly and without jerks (especially where passengers are carried); this will have the two-fold effect of reducing shocks to the machinery and discomfort to the passengers. The main essentials in the control gear are:—(1) Reliability; (2) Incombustibility; (3) Accessibility; (4) Mechanical strength.

In most cases the control gear is fixed where it cannot easily be seen, and is often only visited when a breakdown occurs, hence too much stress cannot be laid on the first-mentioned essential. All contacts should have large areas (face to face, not of the knife type), with one contact of carbon and the other copper, both easily renewable; this combination prevents to a great extent burning of the contacts, and in a well-designed controller the carbon takes practically all the wear and tear due to arcing, and the whole can easily be replaced at a cost of a few shillings.

All breaks and clearances should have an ample margin, and the main current-breaking contacts, if for direct current, should be protected by means of a magnetic blow-out, as this minimises the formation of an arc and lengthens considerably the life of the contacts; all bolts and screws should be fitted with spring or locking washers to prevent them working loose due to vibration, and if iron or steel is used for working parts subjected to the atmosphere, they should be nickel or copper-plated to prevent trouble due to rust, particularly the plungers of solenoids; where dash-pots are used, these should in all cases be easily and effectively adjustable to alter the rate of cutting out the resistance and to accommodate the class of oil available.

The insulation, where possible, should be of mica or porcelain; most other forms rapidly deteriorate, especially in a damp or tropical climate.

The resistances should be amply rated, especially on multi-speed controllers, so that they cannot be damaged if run for long periods with the resistance in circuit; the resistance units should be easily renewable, cast grids or wire nets form a very good arrangement, or, better still, large porcelain bobbins suitably grooved to hold the wire; this type of unit will stand greater overloads than the others mentioned owing to the large mass of porcelain, which rapidly absorbs and dissipates the heat from the wire.

The internal connections should as far as possible be made of bare copper; where insulation is required this can consist of insulating beads threaded on to the wire, and, finally, contacts and all wearing parts should be easily accessible without dismantling the controller.

The starting rheostat should have a large number of steps, and the resistance should be graded in geometrical progression so that the current peaks will be equal when the brush passes from contact to contact; it should also be of such a value as to allow of rapid acceleration of the motor with a minimum starting current, the latter being about 100 per cent. to 170 per cent. of full load running current.

The above remarks apply equally to the auxiliary switches, push buttons, relays and car switches, &c., as these are often the most troublesome; the general practice is now to arrange all car switches with a spring return to the "off" position when the handle is released, with removable handle and renewable contacts; car switches are generally a great source of trouble, and too much stress cannot be laid on the necessity of making them robust both mechanically and electrically. Push buttons have a nasty habit of sticking, and to obviate this all contacts should be face to face, and all plungers should be of porcelain or ebonite; fibre should not be used, as this is a constant source of trouble in damp atmospheres owing to its absorbing moisture, swelling and often causing leakage and shocks.

Where solenoids or magnets are used, it is always advisable to arrange that these are capable of working across the full voltage to obviate the use of cooling coils and their often troublesome switches, this being now quite possible by the patented systems of machine winding carried out by one or two firms. Special attention should be paid to solenoids for use on an alternating-current circuit; these should be of the best possible design, otherwise trouble will arise due to sticking of the plungers, with consequent over-heating and burning out of the windings.

In the general construction of lift control gear small neat castings or drop forgings are, generally speaking, better than stampings, as the latter tend to make a flimsy construction unable to stand up to the work required of them. There are certain parts which it is necessary to design from a mechanical rather than an electrical point of view, particularly the reversing switches of rope-operated controllers; the type at present in general use is by no means satisfactory. These should be amply strong and provided with definite mechanical stops to relieve the switch levers or blades of all pressure.

The systems of control generally used are given below; these by no means cover the whole field, inasmuch as nearly every lift maker has some special system of his own, which is really a means to attain a common end.

1. Hand rope.
2. Car switch.
3. Semi-automatic push button, "Up," "Down," "Stop."
4. Full automatic push-button call from landings and direct from the cage.
5. Full automatic push-button call and direct from both landings and cage.

The above are all arranged for one speed, except (2) which if used on D.C. circuits, can be arranged for two or three speeds with little trouble; this is an advantage with high-speed passenger lifts.

To obtain the greatest possible protection against damage to the lift, the following interlocks or safety devices should be incorporated:—

1. The up and down direction solenoids should be interlocked so that it is impossible to operate both at the same time, even if both up and down buttons are pressed simultaneously.
2. If the lift stops either by the controller or failure of the current, it must not be possible to start it again until the armature or rotor resistance, as the case may be, is reinserted.
3. In push-button systems the first operator to have the preference, all other points of operation being dead until the journey is completed.
4. Means to cut off the current when the cage reaches the top or bottom floor levels, a mechanical knock off being fitted to the car switch to bring it to the "off" position, or a limit switch in the control circuit operated by a tappet on the cage where the push-button system is used.
5. Means to cut off the main supply of current to the motor in the event of over-travel of the cage, this consisting of a switch in the main circuit operated in a similar manner to the above push-button limit switches.
6. In order to assist in stopping the lift in the shortest possible time and accurately at the floor level after switching off, the controller may be arranged to connect the armature across a resistance, the momentum of the armature driving it as a generator and so forming a dynamic brake; this can be arranged so as to have no detrimental effect on the motor or controller.
7. Full protection to the passengers by fitting all entrances to the lift with folding or sliding doors or collapsible gates, each fitted with an automatic electro-mechanical lock, so arranged that the circuit to the controller is broken except all gates are closed and locked, and so as to prevent any gate being opened except the cage is opposite to the same.

With hand-rope control the main reversing switch is operated by two ropes, one of which can pass through the landings and the other through the cage, thus making the lift operative from all points; this system is usually

limited to one fixed speed, that is, there is no intermediate running speed between start and full speed.

Car-switch control is similar to the above, except that the main reversing switch is operated by two solenoids, the final connection being made by means of a two-way switch in the cage, this being the only point where the lift can be operated; this system can be arranged in various ways as under: —

(*a*) Single speed as described for hand-rope control.

(*b*) Two or three speeds obtained by connecting a resistance across the armature to obtain the low speeds; this is very effective, and also has the advantage that it will act as a dynamic brake if there is any increase in the speed of the motor above the normal.

The push-button systems are generally arranged for single speed, although it is possible to arrange them for multi-speed, but the control gear becomes so much more complicated that no real advantage is gained; the most common systems are: —

(*a*) Semi-automatic—the same as the single speed car-switch system, except that three push buttons, marked "Up," "Down," "Stop," replace the car switch, with a similar set on each landing connected in parallel; on pressing the button the lift continues to run until the stop button is depressed; or this can be arranged in the reverse way, so that the lift will continue to run only whilst the button is depressed.

(*b*) Full-automatic "Call" system. This is very much used, and consists of a call button on each landing, which when depressed operates the controller through a relay; the lift then starts and continues to run until it trips a floor-finding switch in the particular relay circuit in which the depressed button is connected, thus breaking the circuit and stopping the lift. The passenger on entering the cage finds a set of buttons numbered to correspond with the various floors; on pressing the required button, the lift starts, travels to and stops at the desired floor automatically, the operation being the same as when calling the lift.

(*c*) A modification of the above system consists of replacing the call buttons on the landings, with a set similar to those in the cage; this enables the lift to be called from, or dispatched to, any floor from any operating point without any person actually travelling in the cage. This system is both expensive and complicated, and, therefore, seldom used, as in most cases systems (*a*) and (*b*) are found to provide all that is required.

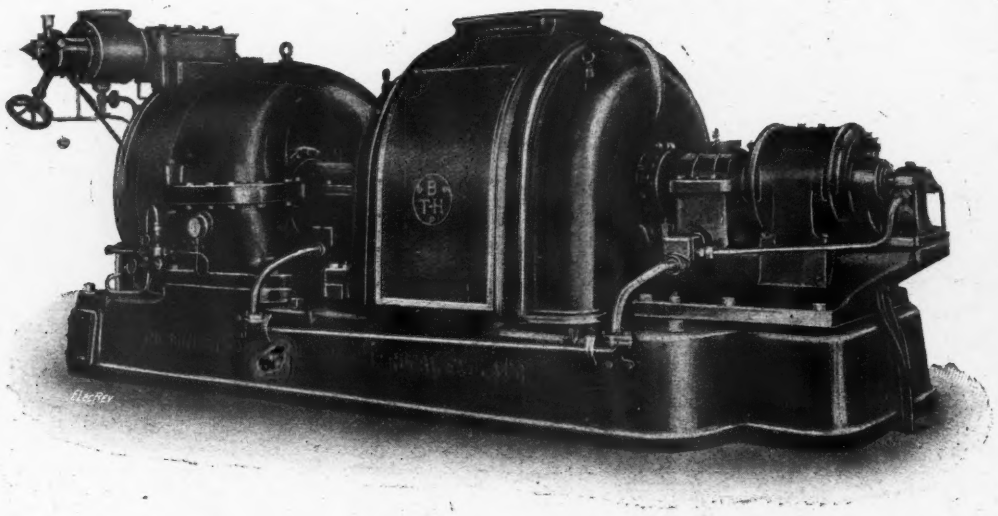
With all these systems af push-button control it is necessary to provide an interlock between the cage and landing push buttons, to prevent operation of the lift at more than one point simultaneously; this is generally carried out by fixing the cage floor on springs, and fitting underneath a small switch connected in the landing-buttons' circuit; when a person enters the cage the floor is depressed, opening the switch underneath, and so rendering the landing-buttons inoperative.

The above systems of control are obtained with alternating current, one, two or three-phase, but using one speed in all cases.

THE NEW PLANT OF THE CHINA LIGHT AND POWER CO., LTD.

The existing power station of the China Light and Power Co., Ltd., of Hong-Kong, China, is situated at Kowloon, and contains gas-engine-driven generators operating on suction gas. The necessity for increasing the output of the station to cope with the growing demand for electricity for power and lighting purposes in Hong-Kong led the managers of the company, Messrs. Shewan, Tomes & Co., to consider the type of prime mover most suitable for driving the new generators. After carefully considering the relative merits of gas-engine and steam-turbine-driven generators, the company, in conjunction with their consulting engineer, Mr. Conrad Mendham, decided in favour of turbo-generators, and contracts were entered into with the British Thomson-Houston Co, Ltd., for the supply of the generating plant and switchgear, and with Messrs. Babcock & Wilcox for the boiler plant.

This generating plant consists of two high-pressure, three-phase, 60-cycle, B.T.H.-Curtis turbo-alternators, rated at 937 K.V.A., 2,200 volts, at 80 per cent. power factor. These machines are provided with direct-coupled exciters, and designed to run at 3,600 R.P.M. when supplied with steam at 180 lb. per sq. in. gauge pressure, superheated 160° F., and exhausting into a vacuum of 27½ to 28 inches. The turbines are three-stage machines, and the sets are each capable of maintaining an output of 1,170 K.V.A. for two hours. The alternators are designed to operate in conjunction with a Tirrill regulator which will maintain a constant voltage within 1 per cent. of normal, under all conditions of load and power factor.



B.T.H.-Curtis Turbine Set supplied to the China Light and Power Co., Hong-Kong.

Air filters are provided, by means of which the cooling air drawn through the windings of the alternators for ventilating purposes is thoroughly cleansed of dust, thus avoiding the necessity of periodically dismantling the machines for cleaning purposes.

To enable the performance of either turbine to be determined at any time, a Lea recorder, fitted with an integrating attachment, is being supplied.

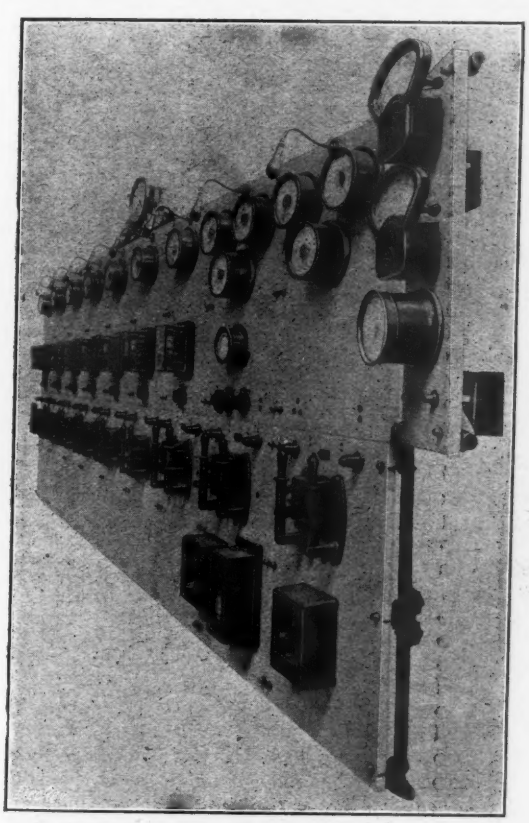
A nine-panel white-marble switchboard, fitted with all the usual operating gear and instruments, is being installed to control the output of the turbo-generators. To facilitate the handling of the load, a duplicate set of bus-bars is provided, and special barriers are being fitted between the panels, enabling the operator to work in complete safety behind any panel after having opened the isolating switches. A swing panel, mounted at the end of the switchboard,

carries the usual synchronising voltmeters and synchronism indicator.

The boiler plant comprises three Babcock & Wilcox boilers having integral superheaters and chain-grate stokers, each boiler being capable of evaporating 9,000 lb. of water per hour from hot feed into steam at 190 lb. per sq. in. pressure, superheated 200° F. Economisers are employed to utilise the heat from the waste gases, and the necessary draught is produced by means of a fan discharging into a self-supporting chimney.

The condensing plant is of the surface type, and arranged for installing immediately below the turbines. Each condenser has a cooling surface of 1,650 sq. ft., and is equipped with rotary-type motor-driven pumps, the cooling water being drawn from the sea through a double set of suction mains. The circulating pumps are so arranged that they can feed into either condenser, as may best suit the requirements of the moment.

The inlet ends of the suction mains are provided with the necessary flap-valves and strainers, but experience shows



B.T.H. Switchgear at Hong-Kong Electricity Works.

that the latter do not prevent the nuclei of small shell-fish, shrimps, &c., from getting into the circulating pipe. In time these nuclei develop, and the precaution has therefore been taken of providing special shrimp-catchers in the generating station.

The largest consumers of power from this station are the Hong-Kong and Whampoa Docks, who take a bulk supply which is led to their premises through a three-core underground cable. This supply is at 2,200 volts, and the outgoing feeder is controlled by suitable distributing panels installed in the main station. The plant installed in the Hong-Kong and Whampoa Docks was also supplied by the British Thomson-Houston Co., Ltd., and consists of two 350-kw., 250-volt, 900-r.p.m., six-phase, 60-cycle rotary converters, with the necessary step-down transformers and control gear. The latter comprises in each case one high-tension a.c. panel, one low-tension a.c. panel, and one direct-current control panel. The rotary converters are equipped with self-synchronising starting motors, reducing the operation of these machines to the simplest possible form.

We are indebted to the British Thomson-Houston Co., Ltd., for the foregoing particulars and accompanying views.

THE MAGNETIC TESTING OF BARS.

By ALBERT CAMPBELL, B.A., A.M.I.E.E., and D. W. DYE, B.Sc.

(From the National Physical Laboratory.)

(*Abstract of Communication to the* Institution of Electrical Engineers.)

For the accurate testing of magnetic materials, until recently it has been the usual practice to employ a uniformly magnetised test-piece, the condition of uniformity being ensured by using a closed magnetic circuit of ring form. This ring form is somewhat difficult to construct, it necessitates rather laborious winding of coils on each specimen, and, unless rings of rather large diameter are used, it is not suitable for high values of the magnetisation. For this reason all kinds of methods have been proposed and used for the testing of material in the form of bars, whether straight or curved. The main difficulties in all these methods have been (1) to obtain uniformity of magnetisation all along the specimen, and (2) to determine the true value of the magnetising field H which produces this desirable result. As a rule it has been the custom to complete the magnetic circuit as well as possible by a yoke or yokes, and to deduce the mean value of H from the number of applied ampere-turns; the unavoidable magnetic leakage, however, is apt to introduce considerable error in the determination of the H.

These difficulties will be avoided if we can find a method for the direct measurement of the H at any portion of the bar. The H is equal to the flux density in the air at the surface of the portion dealt with, and can be determined by means of a small search coil placed very close to the surface of the iron, the axis of the coil being parallel to that surface and in the direction of H.

The coils we have used in the National Physical Laboratory are of various designs, according to the form of the specimen to be tested, some being differential (circular or rectangular) and others single and usually very flat.

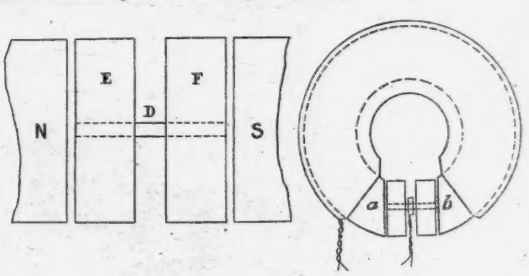


Fig. 1. Fig. 2.

In all cases it is desirable that the whole of the effective area of the coil shall be as near to the surface of the iron as possible, otherwise the value of H obtained may not be the true field acting on the iron. It is important to know the rate of variation near the surface, in order to be able to estimate with what degree of accuracy the search coil reading gives the true value of H at the surface. For this purpose, in May, 1913, we adopted the expedient of winding a third coil (*c*) over two (differential) coils (*a* and *b*). By opposing coils *b* and *c* an outer differential coil is formed with an annular area farther from the iron surface than that between *a* and *b*. A comparison of the values of H obtained with the inner and outer annular coils gives a measure of the radial rate of variation of H.

Dr. E. Gumlich has improved on this arrangement by adding a fourth coil, so as to obtain a still better idea of the variation of H with the distance from the iron surface.

When the cross-section of the iron rod is small it is essential to wind the differential coils with extremely thin wire, so as to keep very close to the iron and yet have the product, (No. of turns) × (difference area), sufficiently great for good sensitivity. With enamelled wire of 0.07 mm. diameter (diameter of copper, 0.06 mm.), 1,000 turns can be got into a winding space of about 6 sq. mm.

The flat search coils are wound on thin plates of insulating material. For the smaller coils thin plates of glass (0.8 mm. thick) with ground edges form very convenient cores. The turns, which may be in several layers, are held in place by a winding of silk thread across them, the whole being made solid by paraffin wax or varnish. Semi-circular coils are wound on flat paper cores, well varnished with cellulose acetate enamel, bent round into tunnel shape and allowed to dry hard.

For search coils used to measure H, in general it is only necessary to know two constants of the coil, namely, its resistance and N_2s, the product of the number of turns and the mean area. For coils by which the total flux (Φ) is measured, we need only know N_2; if B is to be determined, *s* should also be known. The number of turns is usually counted when the coil is being wound. In differential coils it is absolutely essential that the inner and outer coils shall have

exactly equal numbers of turns. Sometimes the mean area can be deduced with accuracy from the dimensions of the coil, but as a rule it is best to determine the N_2s by placing the coil in a known magnetic field or by determining the mutual inductance between the coil and a suitably wound solenoid or other standard coil.

When either B or H is measured by the help of a search coil, the simplest procedure is to observe the throw on a calibrated ballistic galvanometer when the B (or H) is either reduced to zero or reversed.

In the original form of Ewing and Low's Isthmus method rather elaborate coned pole-pieces are required, with accurate mechanism by which the test-bar along with these pole-pieces can be quickly turned end for end in a strong magnetic field. A much simpler system, shown in fig. 1, was found to be quite satisfactory. Instead of the cones, thick soft-iron disks E and F form the pole-pieces, and these do not touch the magnet poles, but are separated from them by small air-gaps (1 or 2 mm. distance). The test-piece D is fitted into central holes in the flat pole-pieces, which are clamped in an independent frame so that they can be removed together from between the

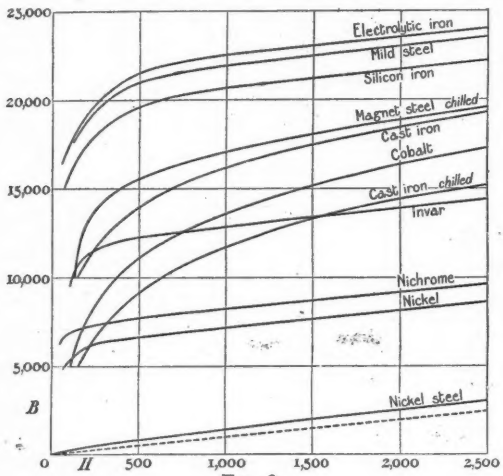


FIG. 3.

Magnet steel (chilled): Tungsten 3.3 per cent., carbon 0.75 per cent.

Invar: Iron 74 per cent., nickel 36 per cent.

Nickel, electrolytic: Ni 98.8 per cent., Fe 0.6 per cent., Cu 0.2 per cent., Mn 0.3 per cent.

Nickel steel: Ni 19.9 per cent., C 0.41 per cent., Mn 0.96 per cent.

poles. Instead of reversing the direction of the test-piece, the magnet is so designed as to allow quick reversal of the magnetic field. It consists (fig. 2) of a well laminated iron core of nearly square section (8 cm. × 7 cm.) formed of ring stampings of about 22 cm. mean diameter, the polar air-gap *a b* being about 8 cm. across. The winding consists of about 1,000 turns of copper wire of 2 mm. diameter (No. 14 S.W.G.), with a total resistance of about 2.2 ohms.

The whole construction is extremely simple; the laminated magnet had not been specially designed for the purpose. The entire absence of fitted or clamped magnetic joints is a distinct advantage from the point of view of construction, and appears to have no disturbing effect in the tests, although the presence of the outer air-gaps lowers somewhat the maximum H obtainable in the central gap.

The specimen tested is in the form either of a rod 7 cm. long and 0.5 cm. in diameter, or an equivalent bundle of strips or wires. It does not seem essential that the strips should be so closely packed as nearly to fill the holes in the pole-pieces, for, when the section of the bundle is reduced by 50 per cent. by removing some of the strips, the total observed reduction in permeability is only of the order of 1 per cent. From H = 1,000 up to H = 3,000, rods shorter than 7 cm. gave satisfactory results so long as they entered the holes in the pole-pieces to a depth of at least 0.5 cm.

With such a large electro-magnet, when the current is suddenly reversed, in the worst case the current reaches 99.3 per cent. of its full value 0.5 second after the circuit is closed. With a ballistic galvanometer of 8 seconds' complete period the possible errors due to this cause appeared to be practically negligible.

At the middle point of the test-rod is placed a small ebonite bobbin with an inner winding of 40 turns for measuring B, and three outer coils of 400 turns each, used differentially as already described, for determining H. These coils are of enamelled copper wire of 0.06 mm. diameter (No. 46 S.W.G.), with an axial length of 4 mm., the mean diameters of the inner and outer annuluses being 6 mm. and 12 mm. respectively. From the results of a large number of experiments with various materials it has been proved that the magnetic field round the central portion of the rod is wonderfully uniform from H = 150 up to H = 3,000.

With rods of small section, and more particularly with small bundles of strip, the difference between the cross-section of the iron and the area of the search coil for B is considerable, and this necessitates a large correction on the observed value of B. If s = area of iron, s_1 = search coil area not occupied by iron, then True b = Observed B − H s_1/s. The correction increases in proportion to H. To avoid the trouble of applying this varying correction to each observation, we have found it convenient to eliminate the term H s_1/s by means of a compensating device consisting of a small mutual inductometer arranged with its primary coil in series with the magnetising circuit of the magnet, and its secondary coil connected in opposition to the search coil for B, in the ballistic galvanometer circuit.

The apparatus can be used, not only for the determination of permeability curves, but also for hysteresis loops, including the remanence and coercive field. The remanent magnetism of the electromagnet, although it makes its appearance, does not introduce any errors, since the true values of H are given by the search coils.

The determination of the remanence and coercive field is most important for hardened steel used for permanent

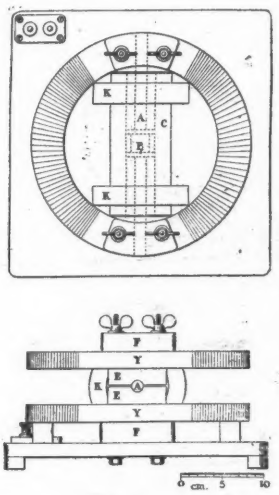


FIG. 4.

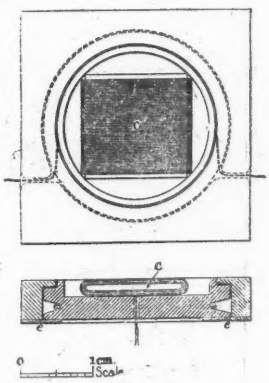


FIG. 5.

magnets, and here the tests must be made with high values of $H_{max.}$ (say 400 to 500). In determining the coercive force corresponding to a high value of $H_{max.}$, the galvanometer throw measuring the coercive force (H_0) is usually small compared with the throw due to $H_{max.}$, and it becomes rather difficult to read the small throw with sufficient accuracy. In order to increase the accuracy, one way is to raise the sensitivity of the galvanometer and to balance out accurately the complete throw from $+H_{max.}$ to $-H_{max.}$ by the help of an adjustable mutual inductance connected similarly to that described above for the correction of B.

In fig. 3 are given a number of H-B curves obtained by the apparatus already described, the samples being in the form of thin rods or bundles of strips. As will be seen, most of the materials are of interest from a practical point of view.

The lowest curve in the diagram is the straight line for air (permeability = 1). All the other curves ultimately tend to become parallel to the air line as the magnetisation is increased, close parallelism indicating that the material has reached the condition of magnetic saturation.

In the apparatus already described the main disadvantage is that the rods tested must be of small diameter. For testing round rods up to 2.5 cm. in diameter the authors have constructed a special apparatus of a type somewhat similar to Gumlich's most recent design. The general arrangement is shown in fig. 4.

The test rod A, surrounded by a bobbin wound with a magnetising coil C, is clamped, by the help of suitably bored iron end-pieces EE, between the two circular yokes YY. FF are pieces of hard wood to equalise the pressures. (For bars of rectangular section the end pieces EE are not bored, but merely faced flat.) In order to increase the uniformity of the magnetising field near the middle part of the central bobbin, there are two additional magnetising coils KK, and the yokes also are wound with coils with their turns somewhat crowded towards each of the magnetic joints. All of the magnetising coils are in series. The central solenoid has 950 turns of No. 16 S.W.G. wire (1.63 mm. diameter), coils KK 150 turns each, and the yokes a total of 200 turns. A current of 12 amperes gives H = about 1,000.

Experiments showed that the additional windings greatly improved the radial uniformity of H at the middle of the bar for the range H = 50 to 150, but slightly decreased the uniformity at higher ranges (H = 400). On the whole, the average improvement is satisfactory, and appears to exclude errors greater than 1 per cent. Without further precautions the apparatus should not be used for permeability tests with values of H below 30. The H and B search coils are on a small bobbin P at the middle part of the test bar. For a rod of 1.25 cm. diameter each annular H coil has 1,800 turns, the

innermost coil being at a mean radial distance of about 2.5 mm. from the surface of the iron. With bars of rectangular section flat search coils are used, which have the advantage of getting much closer to the iron surface (mean distance = about 1.5 mm.); two coils in series may be used, one on each side of the bar. The authors have also made satisfactory tests on rectangular bars of magnet steel in a short solenoid (22 cm. long) heavily wound and without any yoke. Very good uniformity of H can be ensured by extending the effective length of the bar by butting against its ends two soft-iron bars about 20 cm. in length.

In all the methods in which the H search coils are kept in a fixed position with regard to the iron, the throws on the galvanometer can only determine changes in H and not (directly) the absolute values. These values can be determined by pulling the search coil (where possible) quickly out of the field. In general it is difficult to do this, and, even when it is possible, a double throw of the galvanometer may occur, which vitiates the accuracy of the test.

A much better way is to mount a flat search coil so that it can be rotated in a plane parallel to the direction of H (*i.e.*, usually parallel to the surface of the iron). It can then be quickly reversed in position (turning through 180 deg.), and, when calibrated in a known magnetic field, will give directly the absolute value of H at any moment. The mounting of a very narrow reversible coil of this kind is shown in fig. 5.

The search coil *c* is mounted in a thin pulley (5 mm. thick) which can turn in a cell of ebonite with a thin German-silver cheek (*e e*) forming the second bearing. Two threads from the pulley (one of which can be fastened to a spring if desired) allow the coil to be reversed from the outside. Adjustable stops, not shown, limit the turning to 180 deg.

Tests on bars of magnetic steel by this method are in agreement with the results given by fixed search coils. The method is the simplest and most straightforward that we have tried.*

In practice it is desirable to be able to test curved as well as straight bars; for example, the magnets of horse-shoe form used in magnetos. If the curvature is not too great, the H at any part may be measured by means of search coils near the surface, as already described. For the horse-shoe magnets, flat search coils are tied (inside and outside) at the middle of the bend, and over the whole are slipped five or more magnetising coils.

The essential feature of all the foregoing methods is that the value of the magnetising H is not calculated from the somewhat indefinite length of the magnetic circuit and the ampere-turns, but is directly measured by the help of a search coil placed as near as possible to the surface of the iron.

* Many years ago Ayrton and Mather introduced "trigger" coils which turned quickly through 180 deg. for the purpose of measuring flux densities in air.

ELECTRIC LIFTS.

A paper on this subject, from which we extract the following notes, was read by Mr. H. MARRYAT at a recent meeting of the ASSOCIATION OF SUPERVISING ELECTRICIANS. The author points out that though goods lifts are frequently regarded as an inferior class of contrivance, it is only in service lifts wherein no person can possibly travel, that the factor of safety in respect of strength of materials and number of safety devices can be reduced justifiably below the standard maintained for passenger lifts. No form of notice or warning is sufficient to prevent a man risking his life if it will save him a little stair or ladder work.

The two main types of lift are sheave-driven and drum-driven respectively. In favour of sheave driving, Mr. Marryat advances the possibility of using more ropes, and hence smaller ropes than can be accommodated conveniently on drums. The rope of smaller diameter and the larger diameter to which it is bent on sheaves, as compared with drums, give longer rope life, and the speaker cited ropes still in use on sheave lifts after 15 years' service, whereas drum-driven ropes lasted only three years under similar conditions. A most important advantage of sheave driving is that in the event of over-running, the rope tension is relieved and the sheave slips under the ropes without doing much damage. With drum drive something must break, since the ropes are driven positively; to reduce the risk extra safety devices are needed, and these introduce further possibilities of trouble.

The most favourable arrangement is to place the driving gear at the top of the well and use a sheave just spanning (diametrically) the distance between car and counterweight centres, without the use of leading wheels. To prevent transmission of noise throughout the building, the bed-plate of the gear should be heavy and stiff, and the whole mounted on girders isolated by rubber blocks. A double ceiling, with asbestos or slag packing, may be used over the well. Architects frequently make the erection and maintenance of an efficient and reliable lift most difficult by neglecting to consult engineers as to the head room and pit depth required in the well. Lift wells should preferably be enclosed from floor to ceiling on each landing. In any case this should be done on the counterweight side. Several decorators have been decapitated by the counterweight when working over the top of a 7-ft. enclosure.

Manufacturers of lifts generally counterbalance the weight of car and attendant, plus 40 per cent. of the maximum load to be carried, but by examining the actual conditions of working when the lift has been placed in commission, 50 per cent. or greater energy economy can frequently be effected by altering the counterweight. The energy required to start and accelerate exceeds that required to raise a well-balanced lift, hence marked economy can be effected by using automatic lifts or by employing skilled attendants who will bring the car to the correct floor level at the first attempt. Mr. Marryat finds that modern electric lifts cost for energy about one-tenth the water bill of an equivalent hydraulic lift; and in Westminster it is found that 50 electric lifts average only 1,060 units energy consumption (each) per annum. Even a completely automatic electric lift costs not more to maintain than an hydraulic one, and it saves the attendant's salary, which is about five times the total maintenance cost. Rope renewals form the most expensive part of the upkeep of a good lift, and the labour of fitting costs about as much as the ropes themselves, hence it is wise to use the best material available. Top-gear needs only one-third the length of rope that is required if the gear be fixed at the foot of the well. The stranding found most satisfactory for all-round lift work is 6/19 laid round a hemp core; 6/24 and 6/30 wear through more quickly, but the greater flexibility is valuable where small sheaves or drums are used. For a set of four ropes a breaking strain of six times full load on each rope may be allowed; and for two ropes, a similar margin of seven times.

Compound-wound motors with 10 or 15 per cent. of series turns should be used for lift driving, rated for intermittent work. The rated motor horse-power should be about 2½ times the net value given by (lb. out-of-balance, fully loaded) × (lift ft. per min. /33,000). When a worm wheel is used consisting of a phosphor-bronze or gunmetal rim on a cast-iron centre, it is vital that the two parts be thoroughly secured; if the rim comes adrift, or if its teeth wear to stripping point due to defective supervision, all safety devices are cut out except the dog grips on the car, and these cannot operate since the ropes remain taut.

Safety gear can and should be used to a greater extent on electric lifts than on any other type. It must guard against disaster due to broken ropes or over-running at either end of the well, and it must avert the consequences of human carelessness, folly and mischief.

About 90 per cent. of lift accidents are due to there being no car gate or inadequate gate locks. A car gate should always be provided, and in all cases it is desirable, and in automatic lifts it is imperative, that electric gate-locks be used of such construction that the lift cannot be used till all gates are electrically and mechanically locked, and no gate can be opened except that opposite the floor at which the lift is standing. A really good lock should not allow the door to open if it be pulled at the moment when the car is passing in its travel up or down the building. Unless gates are self-closing, a messenger has constantly to run up and down rectifying the omissions of careless passengers; the economy of an automatic lift is then mostly sacrificed. Gates which will close certainly and without banging can best be built on the Continental hinged door principle. Two 15-in. centre-closing panels can be opened inwards with little inconvenience in even a crowded car.

The points requiring special attention in lift inspection are: (1) Adequate lighting by day and night; (2) locking of all gates imperative before the lift can be started; (3) security of locks at all times and under all conditions during working; (4) sufficiency of brake power and effective action of limit switches which should not, however, be reached under ordinary working conditions; (5) adequacy of enclosure. It is highly desirable that all safety devices be tested periodically; they should not be left idle or ill-tended from the time they are installed to the moment they are supposed to act. The duties of maintenance contractors include testing all safety devices and watching wear in all parts.

After the war we may expect a period of great constructive advancement marked, in the lift world, by the perfecting of controller design, simplification of the automatic lift, and co-operation between architects and engineers to effect standardisation.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

By J. R. BEARD, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *December*, 1915.)

(*Continued from page* 831.)

Economical Section of Mains.—Although it is generally known that the economical cross-section of a main is that at which the sum of the annual charges and the value of the energy lost is a minimum, it is seldom that any practical use

is made of the formula. In the case of high-pressure distribution systems, at any rate, the results are commercially useful.

The annual charges which have been taken for underground and overhead mains at various voltages are shown in fig. 1. These are based on average commercial prices, allowing interest at the rate of 5 per cent. per annum, and depreciation at 2 per cent. for underground mains and 3 per cent. for overhead mains, suitable allowance being made for trench work in the former case and for wayleave charges in the latter. With compound interest at 5 per cent. the rates allowed for depreciation are sufficient to enable the underground mains to be replaced after 22½ years and the overhead mains after 17½ years, allowing a scrap value of 20 per cent. in each case. In the case of overhead mains only one curve is given, as up to 20,000 volts the only difference is in the insulators, and this is so small that it is usually worth while to make the line suitable for 20,000 volts, although it may only be intended to operate it at a lower voltage.

The only losses which are important enough to be taken into account in this investigation are the resistance losses in the copper conductors, and in estimating their value it is necessary to take account of the effect of the addition of the load on the load factor of the system.

A system has been taken having a maximum load of not less than 50,000 KW. and an average load factor of 50 per cent.; figures which fairly closely correspond to what may be expected if the system deals with the general demand over a reasonably extended area.

In fig. 2 the full-line curve shows the assumed load curve of the typical system with a load factor of 50 per cent., and the dotted curve shows to an enlarged scale the shape of the corresponding loss curve, which has a load factor of only 35 per cent. From an analysis of the fixed and running charges, the cost per unit of generating these losses at the power stations can be calculated, and to this must be added the fixed charges on the increased capacity of the distribution system necessary to transmit these losses. Since the power stations can seldom be located at the exact electrical centre of gravity of the load, the losses have to be transmitted, on the average over, say, two-thirds of the distribution system and should, therefore, bear two-thirds of the fixed charges of the latter. Taking the cost of the distribution system as two-thirds that of the power stations, the value of resistance losses on the typical system considered is about 0.25d. per unit.

Since the resistance losses over a given time are proportional to the mean square of the current, it is very necessary in calculating them to take account of the shape of the current load-curve. For the typical 50 per cent. load curve given in fig. 2 the R.M.S. current is 1.18 times the average current. The full lines in fig. 3 show the extreme values of this multiplier for different load factors, and the dotted line the approximate values for the usual type of load curve; corresponding extreme and usual values for the load factor of the losses are also indicated.

On the system which we are considering, the load factor of the mains over the whole network would probably average about 40 per cent., and it will be seen from fig. 3 that the corresponding R.M.S. current would be 1.25 times the average current. Calculating the losses on this basis, and taking their value as 0.25d. per unit, the annual value of the losses per mile of 3-phase main is £0.000296 I_r/A, where I is the maximum current in amperes and A is the cross-sectional area of the conductor of each phase in square inches.

By adding the curves of annual charges and value of losses for mains of various sizes for any particular maximum current, a curve is obtained of the type shown in fig. 4, which refers to a 6,000-volt underground cable required to deal with a maximum current of 100 amperes. The most interesting feature of this curve is that the most economical section is not very definite; it is actually 0.09 sq. in., but for 2½ per cent. increase in the total annual costs the section can be increased 44.5 per cent., or decreased 27.2 per cent., the corresponding figures for 5 per cent. increase in annual costs being 65.5 per cent. and 36.1 per cent. respectively. It follows that it is not sound practice to cut the section of mains too fine, more especially since it is a most expensive matter after a main is once laid to increase its carrying capacity if this should prove too small.

A corresponding curve has been calculated in exactly the same way, but assuming a system load factor of only 40 per cent. This is shown dotted in fig. 4 and gives a reduction of only 2 per cent. in the most economical section and 2 per cent. in the minimum total annual cost per mile, compared with the original curve. The difference between the two curves is so small because the reduction in the number of units lost at the lower load factor is nearly balanced by the extra value of the losses per unit due to the lower load factor of the losses. A further curve has also been added—shown chain dotted—to show the extent to which the results are affected by the price of copper and lead. The original curve corresponds to basis prices of £60 and £15 per ton respectively, while the chain-dotted curve corresponds to basis prices of £80 and £20 per ton. This shows that the influence of ordinary variations in metal prices is negligible.

By plotting a series of curves similar to the full-line curve in fig. 4, the curves shown in fig. 5 have been obtained. The full lines in fig. 5 give, for underground and overhead mains at various voltages, the most economical cross-section for any given maximum current, while the dotted lines show the increased cross-section corresponding to 5 per cent. extra annual cost. It will be noticed that up to 11,000 volts in the case of underground mains, and up to 20,000 volts in the case of overhead mains, the voltage makes no difference to the economical cross-section; and from fig. 1 it will be seen that this is because between those limits the annual charges happen to differ by approximately constant quantities which are independent of the cross-section.

To show how the economical cross-sections compare with

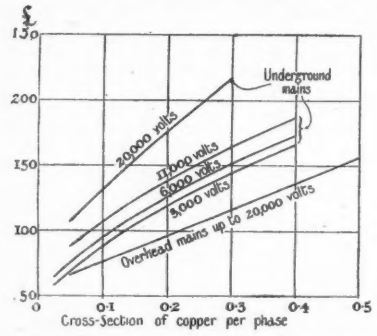


FIG. 1.—Annual Cost per Mile of Interest and Depreciation for Various Types of 3-phase Mains.

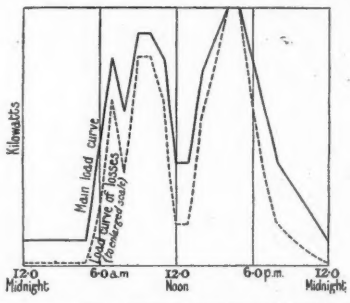


FIG. 2.—Load Curve of System with 50 per cent. Load Factor, and Curve of Losses with a Load Factor of 35 per cent.

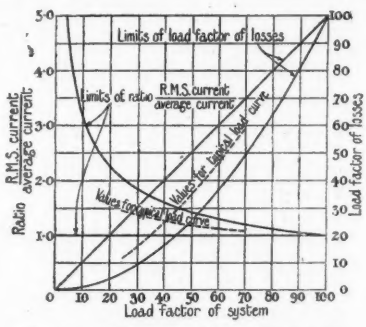

Limits of load factor of losses
Limits of ratio R.M.S. current / average current
Values for usual load curve
Load factor of losses
Ratio R.M.S. current / average current
Load factor of system

FIG. 3.—Effect of Shape of Load Curve on R.M.S. Current and Load Factor of Losses.

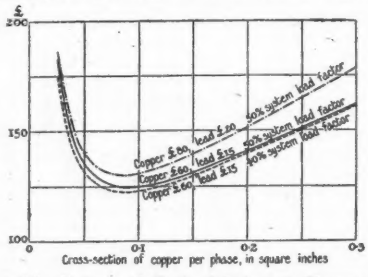


FIG. 4.—Combined Annual Cost of Interest, Depreciation, and Energy Losses per mile of 6,000-volt Underground Main carrying a Maximum Load of 100 amperes.

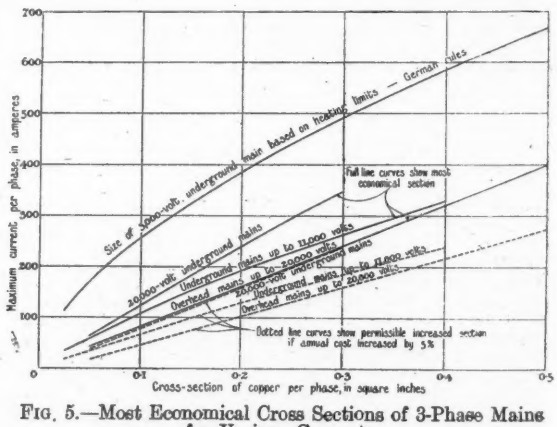

Maximum current per phase, in amperes
Size of 3,000-volt underground main based on heating limits — German rules
Full line curves show most economical section
20,000-volt underground mains
Underground mains up to 11,000 volts
Overhead mains up to 20,000 volts
Dotted line curves show permissible increased section if annual cost increased by 5%
0
0·1
0·2
0·3
0·4
0·5
Cross-section of copper per phase, in square inches

FIG. 5.—Most Economical Cross Sections of 3-Phase Mains for Various Currents.

sections settled by considerations of the safe carrying-capacity, a further curve has been plotted showing the carrying-capacity of armoured 3-core 3,000-volt cable on the basis of the rules of the Verband Deutscher Elektrotechniker. As the rules refer to continuous loads, and the maximum load is usually not maintained for a sufficient time to heat up the cable fully, the curve has been plotted on the assumption that the equivalent heating current is the mean between the R.M.S. current and the maximum current, *i.e.*, 0.75 of the maximum current in the present instance with a 40 per cent. feeder load-factor. The reduction for voltages up to 11,000 is not more than 10 per cent., but unfortunately no figures are available at present for 20,000-volt cables. It will be seen that except for 20,000-volt cables the economical section gives an overload margin of as much as 100 per cent. in nearly all cases, and even for 20,000-volt cables it is evident that a considerable margin exists, so that it is quite permissible to settle the cross-section of mains on the basis of maximum economy. That it does not pay normally to operate cables at the maximum current density allowed by heating-limits is of interest, since it means reduced voltage-drop per mile and consequently an increased radius of distribution for a given voltage.

From the series of curves used in determining the economical sections it is also readily possible to find the minimum annual costs of interest charges, depreciation, and losses per mile of main for given maximum currents, on the assumption that the economical sections which correspond to those

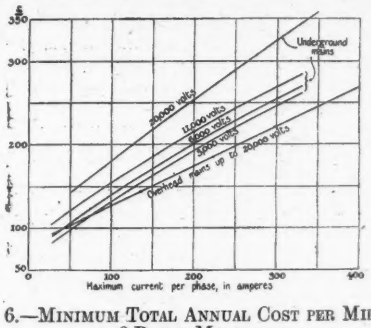


Fig. 6.—Minimum Total Annual Cost per Mile of 3-Phase Mains.

currents are used. If an allowance for repairs is added, the resulting figures will give the total minimum annual cost per mile of main, thus providing a definite basis on which the relative economy of alternative arrangements of mains can be determined. The curves in fig. 6 have been obtained in this manner, the allowance for repairs being taken as a certain percentage of the cost of a 0.15 sq. in. main, since repairs consist almost entirely of jointing and labour and their cost is, therefore, independent of the cross-section. The percentages which have been taken are 1 per cent. for underground mains and 2 per cent. for overhead mains, but these must only be looked upon as approximations, since the cost of repairs depends on so many conditions.

(*To be continued.*)

THE FRENCH ELECTRICAL INDUSTRY.

The liberation of the country from the Germanic element is felt to be no less profoundly necessary in France than in Great Britain, Italy, and Russia, and our French friends have, therefore, been engaged in a discussion for some months past in relation to the best methods to be adopted so as to develop the national industry in connection with trade in the home market and also in the markets of the world. In the *Lumière Electrique* in particular many pages have been filled with arguments and suggestions, and it is fitting to refer to these at the present time, although the task is somewhat difficult having regard to the numerous points raised in the course of the discussion. Let us, however, select, by way of a beginning, the important question of laboratory work, and in doing so we cannot do better than reproduce the beautiful words which were quoted from the well-known scientist, M. Pasteur, in the course of a lecture which was delivered before the Conservatoire des Arts et Metiers in Paris last February. The words, which were uttered by Pasteur as far back as 1868, are really as pathetic as they have proved to be prophetic, and they are particularly applicable to the electrical engineering industry. "Take an interest, I implore you," declared Pasteur, "in these sacred abodes which are designated by the expressive name of laboratory. Ask for them to be multiplied and embellished; they are the temples of the future, of riches and of welfare. It is there that humanity grows, becomes stronger and better. There she learns to read in the works of nature, works of progress and of harmony, whilst her own works [those of humanity] are too frequently those of barbarism, of fanaticism, and of destruction." Again quoting these words, M. J. Violle, discussing the future of the physical resources of France in October, stated that had the suggestions been acted upon they would have enabled France to have paid the 1871 war indemnity several times over in the course of a few years.

Applying the Pasteur theory to the present, M. Violle suggests that the principals of the large French works should become imbued with these thoughts. Without laboratories there would be no inventions, no improvements even in the daily methods of working. The directors of the financial institutions, in his opinion, should also meditate on the words and combine with the technical men to secure fruitful results. But the high banking circles have often exploited the taste for exotic investments by diverting to other countries considerable sums which they have refused to guide into the channels of national industry. Unfortunately, the French do not stand alone in this respect, as we in Great Britain know to our deep regret and industrial loss. M. J. H. Jacobsen, dealing with electrical development, in November, goes even further than M. Violle in the matter of laboratory work, as he suggests that from the standpoint of patriotism and prevision, it might be expected that those who advised capitalists would support *services d'etudes* and place their powerful organisations at the disposal of national industry, as well as the great influence which they exercised upon the investment of capital.

Leaving now the question of laboratory work, we next come to the problem of production. M. Jacobsen, who has followed M. Victor Cambon and other authors, fully recognises that the electrical situation in France must be faced, as it is only by admitting and considering the difficulties that it is possible to propose remedies. German prosperity, as he states, is solely based upon the co-operation of capital and industry, and only such co-operation in France will enable the French to reach as high a stage of development as that of Germany—a matter which is of the highest importance. But the author is a little afraid—and his observations in this direction may perhaps be peculiarly applicable to schemes now in progress in Great Britain—that too great a disposition exists to form new groups to assist manufacturers to secure new markets abroad or to act as substitutes for these firms abroad. In his opinion, the French should guard themselves against the creation of new groups under existing conditions, as the multiplicity of organisations leads to a too great division of effort. Various organisations already exist for export purposes which only require to be modified so as to reach a definite programme which would ensure success, whereas new associations would have to overcome the difficulties which the present organisations have been confronted with and have surmounted. In fact, M. Jacobsen seems disposed in favour of some definite combination to which all parties would adhere, and presumably this would be subdivided into sections.

Having established this point to his own satisfaction, M. Jacobsen expresses himself definitely against the question of the export trade forming the starting point of development. Exports, he declared, are simply a result of intensive rational production, the first effect of which is to enable makers to reduce prices in the home market and to wholly supply the needs of the home market, so that foreign competition is driven out. An industry which has reached this position has attained to such importance that, in the words of the author, it is automatically approached by the local export commission agents, and then, as a consequence, it is approached by the representatives or agents abroad. Indeed, the continuous development of the industry has given rise to over-production, which enables the firms to respond to the demands of exporters and thus tends to the distribution abroad of the machinery and plant. We fear, however, that experience would scarcely fit in with this theory of automatic expansion abroad. M. Jacobsen nevertheless is on safer ground when he contends that the French electrical firms do not attach sufficient importance to applications from merchant houses, seeing that some of them in the past have purchased in France German machinery for export to South America. This proves, in his opinion, that the condition of intensive rational production has not been fulfilled, and that the French, therefore, were not ready to export; but he overlooks the fact that the Teutonic plant might have been, and in all probability was, offered at the so-called slaughter prices, which would commend themselves to merchants who never took national sentiments into consideration in business transactions. At any rate, the author returns to his contention of success being founded upon the co-operation of capital and industry, with the addition of the condition that it is necessary to grant long credits.

If we now come to more solid ground—ground which is common alike to French and British firms—it is mentioned that the whole of the country is interested in the industrial side of the question as well as the financial side. The financial yield of well-organised industry, M. Jacobsen remarks, is much greater, at least for the capitalist, than the best Government loan; he has obviously in view certain German firms. It is, therefore, regrettable that the French banks do not more frequently devote money to industry. This is due to the circumstance that the issue of a Government loan is much more advantageous to a bank than the emission of industrial shares under normal conditions; but if the profits realised by the banks on foreign loans were reduced the banks would naturally turn to industry. It is here that the author raises the problem of financial support being given to laboratory investigation, to which reference has already been made.

He adds, however, that if the banks were to assist in the development of the industry the financial yield would be equally as important as that appertaining to the flotation of foreign loans. M. Jacobsen also submits that the plain co-operation of finance and industry alone cannot solve the problem of industrial expansion, and he proceeds to discuss the part which must be played by the staff and the workmen in this direction, quoting from M. Cambon and M. Vogt as to the necessity for granting greater facilities for the improvement of the technical education of the men and the apprentices, the latter of whom should be adequately remunerated as soon as they become useful to their employers. We will, however, refrain from dealing further with this matter on the present occasion, particularly as the labour problem in France had assumed a grave aspect before the war, and will become still graver when peace has been proclaimed owing to the increased scarcity of workmen, from which France has been suffering for some years past.

One more matter may be raised in conclusion. It was brought forward by M. R. Légouez, and relates to a commercial question: the prevention of fraud or the passing off as of French manufacture goods made in other countries, the chief aim being against enemy countries. M. Légouez, starting from the premise that French consumers may be expected to give preference to national products so as to develop national industries, recommends electrical manufacturers to follow the example of the Federation of Producers of Ironmongery and of a second federation by the adoption of a characteristic trade mark. These federations have introduced a trade mark in the form of an oval ring, in the centre of which appears the word "France"; in the upper portion is the name of the trade organisation or chambre syndicale, and in the lower part is the name of the class of products protected by the trade mark, together with the particular number allocated to each firm using a trade mark. It is assumed that the adoption of this form of trade mark would be a guarantee of nationality, and that it would prevent fraud. We learn from another source—not French on this point—that the idea of the French promoters of the scheme is to secure the general use of the trade mark in that country, that it is desired to bring the trade mark under the control of one huge combination of associations for this purpose, capable of proceeding legally against any infringements from any source whatever, and that legislation would be necessary to secure the execution of the whole of the programme. With these observations we leave the French industry for the present, only remarking that the trade mark idea has found commendation also at the hands of an Italian contemporary.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

17,411. "Electrical apparatus for heating liquids." W. H. Smith. December 13th. (Complete.)

17,412. "Liquid-operated switches." W. H. Smith. December 13th. (Complete.)

17,413. "Electrical apparatus for heating liquids." W. H. Smith. December 13th. (Complete.)

17,419. "Braking devices for electric motors." Maschinenfabrik Oerlikon. December 13th. (Convention date, December 11th, 1914, Switzerland.) (Complete.)

17,453. "Production of X-rays." J. M. Davidson. December 13th.

17,455. "Installations and apparatus for use in wireless telegraphy and telephony." E. Bellini. December 13th. (Complete.)

17,474. "Electro-magnetic relays." C. B. Burdon. December 14th. (Siemens & Halske Akt. Ges., Germany.) (Complete.)

17,480. "Construction of cord grip-holder for use in connection with electrical apparatus." G. Markt. December 14th.

17,497. "Electric control mechanism." O. H. Pieper & A. F. Pieper. December 14th. (Convention date, October 15th, 1915, U.S.A.) (Complete.)

17,503. "Auxiliary means for suspending electric lights." C. F. Millard. December 14th.

17,533. "Electrical devices to be used on taxi-cabs and the like." H. Richardson & H. E. Gill. December 15th.

17,538. "Electrically-operated horns." H. Lucas & W. H. Edwards. December 15th.

17,542. "Projector lamp for use with incandescent filaments." R. Bosch (firm of). December 15th. (Convention date, February 18th, 1915, Germany.) (Complete.)

17,551. "Microphones." F. Morano. December 15th. (Divided application on 82/15, January 2nd.) (Complete.)

17,580. "Electron-emitting cathodes and process of manufacturing the same." A. M. Nicolson & E. C. Hull. December 16th. (Convention date, December 26th, 1914, United States.) (Complete.)

17,581. "Automatic call distributing systems." E. B. Craft & J. N. Reynolds. December 16th. (Convention date, December 19th, 1914, U.S.A.) (Complete.)

17,592. "Compressors." British Thomson-Houston Co., Ltd. December 16th. (General Electric Co., U.S.A.)

17,595. "Machines for generating and distributing electric currents." F. L. Hollister. December 16th.

17,615. "Loading coils for superimposed telephone working and other purposes." C. E. Hay & H. W. Sullivan. December 16th.

17,629. "Reproducing a light in lamps, electric lamps and flash signals immediately producer is out." A. Batchelor & W. Batchelor. December 17th.

17,664. "Electro-mechanical colour effects device for use in theatres and the like." H. Richardson, H. E. Gill, & J. A. Molloy. December 17th.

17,677. "Means for transmitting electric impulses from a standard clock to impulse or secondary dial clocks." W. J. L. Smith. December 17th.

17,690. "Electrical protective devices.' British Westinghouse Electric and Manufacturing Co., Ltd. December 17th. (Addition to 10,130/15. Convention date, December 29th, 1914, U.S.A.) (Complete.)

17,691. "Electric signalling." International Electric Co., Ltd., H. E. R. Roose, & R. G. le Noir. December 17th. (Addition to 3,520/15.) (Complete.)

17,713. "Electrically-heated stove or open fire." G. A. C. Thynne. December 18th.

PUBLISHED SPECIFICATIONS.

1914.

4,345. Transformation of Frequency or High-frequency Alternating Currents for Wireless Telegraphy and Telephony. Soc. Marius Latour et Compagnie. February 19th. (February 20th, 1913.)

19,045. Telegraphy. W. M. Bruce, Jun., & United Telegraph and Cable Co. August 25th.

23,171. Control of Electric Motors. A. H. Curtis, E. W. Short, and Igranic Electric Co. November 27th.

23,726. Electric Fire Alarm Apparatus. N. Bendixen & M. B. Mountain. December 8th.

23,749. Protective Arrangements for Electrical Systems. J. F. Watson, F. G. Waters, and Callender's Cable & Construction Co. December 8th.

1915.

112. Galvanic Batteries. C. B. Burdon (Siemens Schuckertwerke Ges.). January 4th.

939. Arrangements for Telephone Systems. O. Imray. (Siemens and Halse Akt. Ges.). January 20th.

1,088. Methods of Exhausting Incandescent Lamps or similar Glass Receptacles. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). January 22nd.

1,612. Electric Spark-quenching Apparatus. A. M. M. Goby. February 1st.

1,684. Electro-magnetic and Vacuum Lifters. J. P. C. Charlebois. February 2nd.

2,164. Telegraphic Apparatus. E. C. R. Marks (Delany Foreign Co.) February 10th.

3,419. Electric Signalling Systems. A. Stern. March 3rd.

3,433. Reactance Coils. P. Torchio. March 3rd. (Addition to 11,116/14.)

5,554. Electric Motor Meters. British Westinghouse Electric & Manufacturing Co. April 13th. (April 15th, 1914.)

7,271. Electric Meters for the purpose of Compensating for Temperature Variation. E. Fawssett. May 14th.

8,303. Insulation Division Piece or Partition for a Controller Arc Deflection, Circuit-breaker, and the like. W. R. McRae & R. Russell. June 4th.

8,376. Safety Device for use with Electrically-driven Vehicles. W. V. Turner. June 5th. (October 24th, 1914.)

9,110. Oil-cooled Electric Transformers. A. Duckham. June 21st.

15,148. Device for the Protection of Electric Installations against Excess Voltage. Soc. Generale des Condensateurs Electriques. October 26th. (October 26th, 1914.)

The Metric System.—The *Standard* states that the reported decision of the "South German Cotton Industrials," which is the principal body controlling the cotton industry in the Central Empires, to abandon English standards of measurement in yarn counts for the metric system is entirely satisfactory to the growing multitude of British manufacturers and merchants who advocate the adoption by the British Empire of the metric system of weights and measures and a decimal system of coinage. Germany, when she tried to steal our cotton industry, was forced to use our measurements at first. The abolition of British standards of measurement in Germany only matters to us at the moment so far as it may give her an advantage in export trade with neutrals, and she has no cotton to spare just now for that; but it will be a factor for serious consideration after the war. Linen manufacturers and silk spinners in Germany are following suit.

Reform of our coinage, weights, and measures on a decimal basis is one of the objectives of the British Manufacturers' Association, which has been formed to urge upon the Government the necessity of making adequate preparations for trade competition with Germany after the war. A representative of the *Standard* was informed:—"We feel that the introduction of the metric system into the British Empire in its entirety is one of the most urgent needs of British commerce. The change will be so colossal, however, that we feel that the appointment of a Minister of Commerce, whose duty it would be to deal with such far-reaching problems as this, must come first. The advantages to be gained are so indisputable that, apart from the cost and temporary inconvenience of the change, there is surely no serious case against it. The metric system is very easily learned, and people accustomed to calculate in acres, feet, inches, bushels, and gallons can adapt themselves very quickly. The saving of time in marketing and clerical work would be enormous. Coinage reform could come later, and, more gradually, as the present coinage was called in, but the extensive use of paper money due to the war would make the coming year a particularly favourable time for the change, and our intimate alliance with France is an additional reason for adopting a decimal system of monetary calculation now. In the era of strenuous commercial competition which is certain to follow the war we shall be greatly handicapped, as we have been in the past, by the retention of weights and measures which are not used outside the British Empire."

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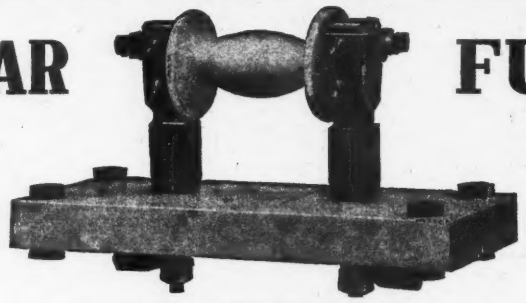

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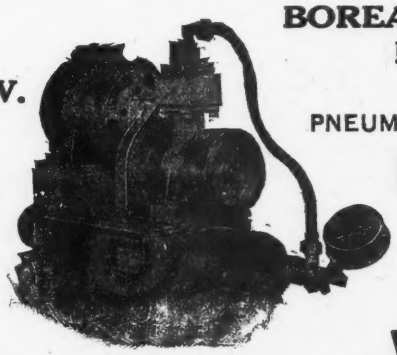

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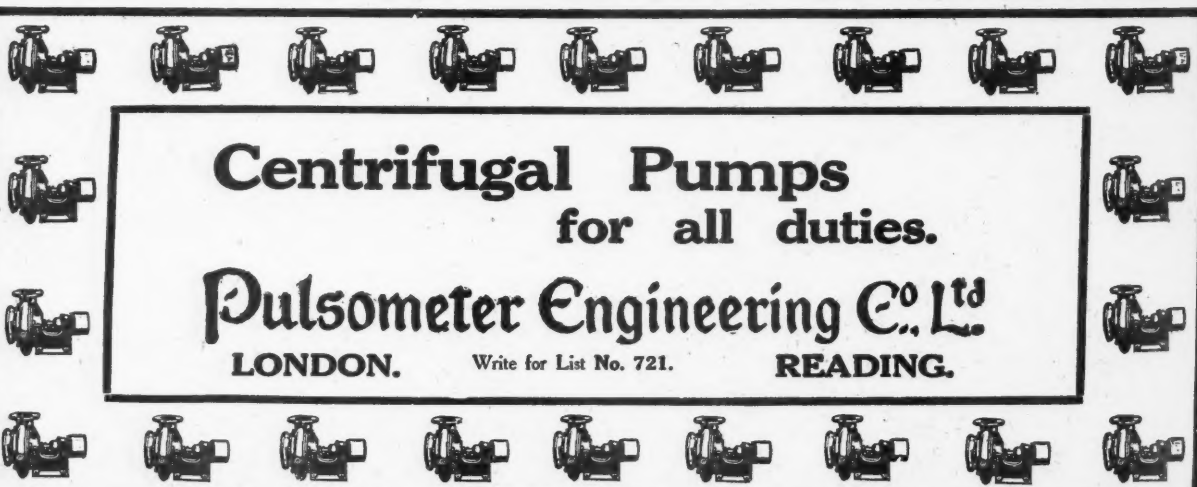

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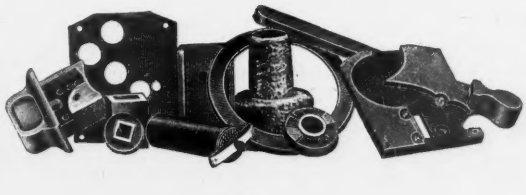

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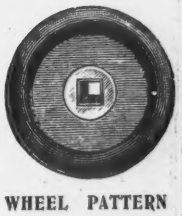

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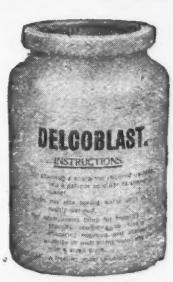

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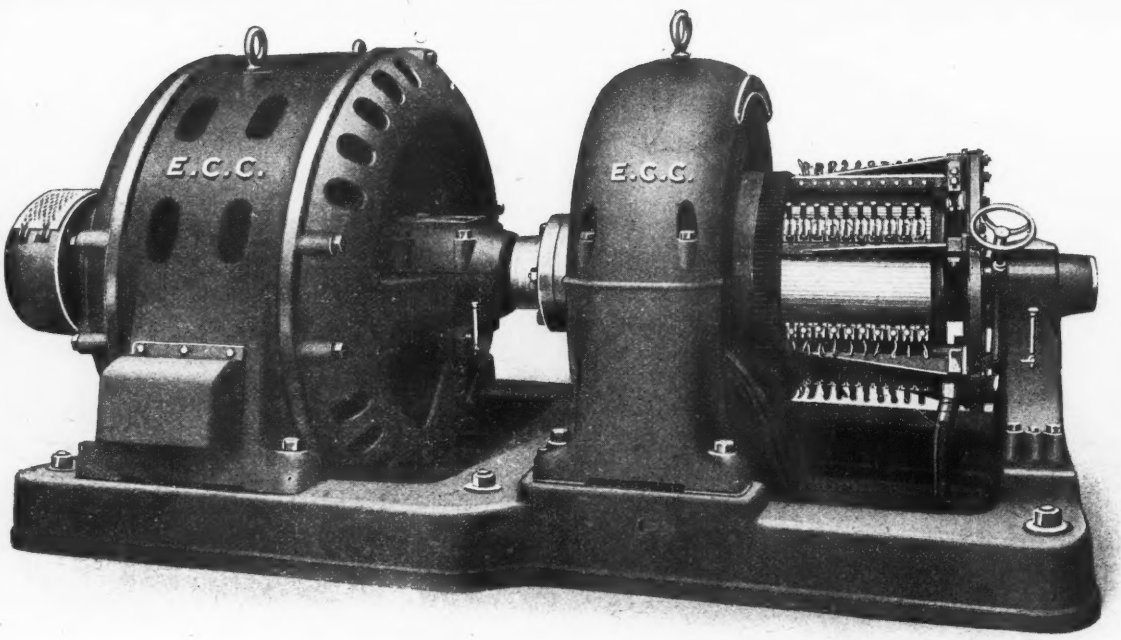

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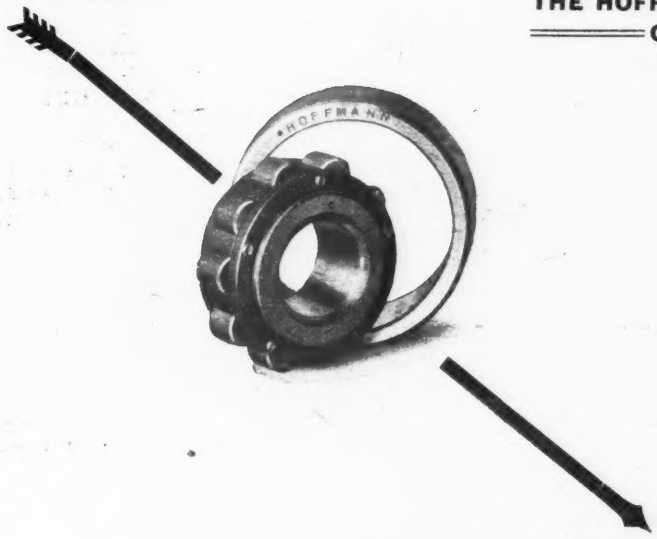

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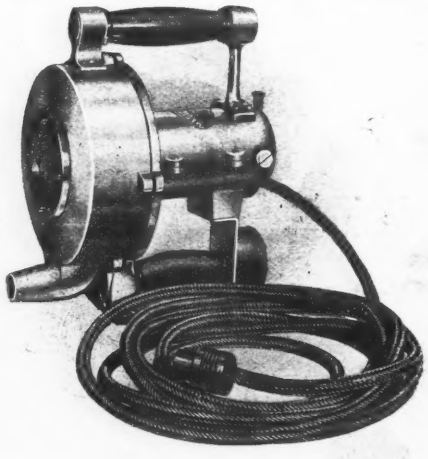

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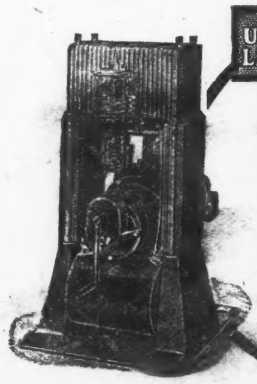

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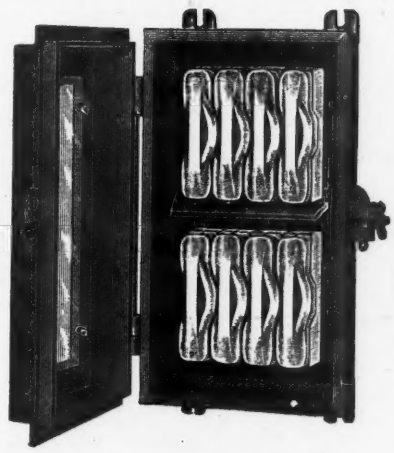

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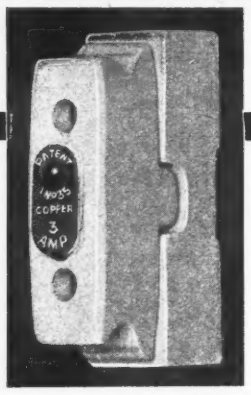

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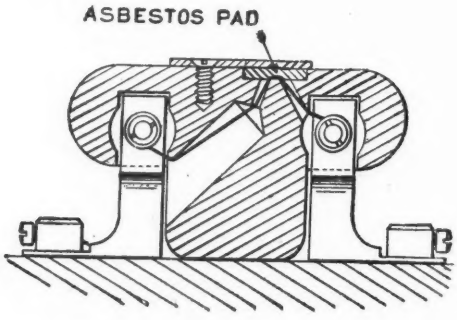

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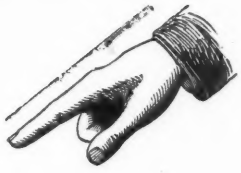

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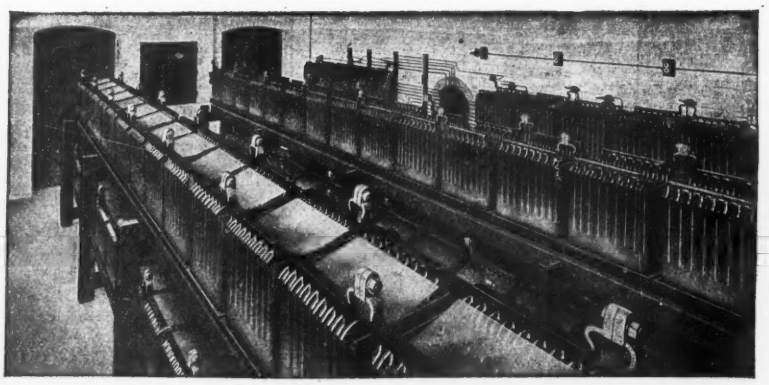

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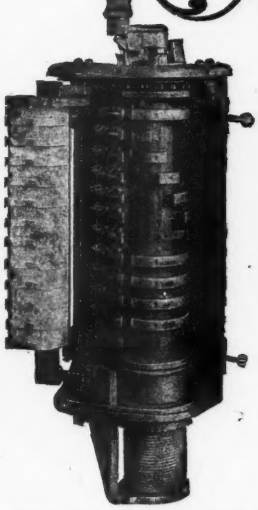
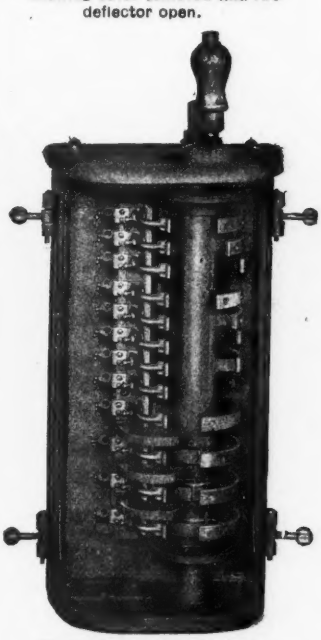


Continuous-current Crane Controller, showing cover removed and Arc deflector open.



Alternating-current Crane Controller, showing cover removed.

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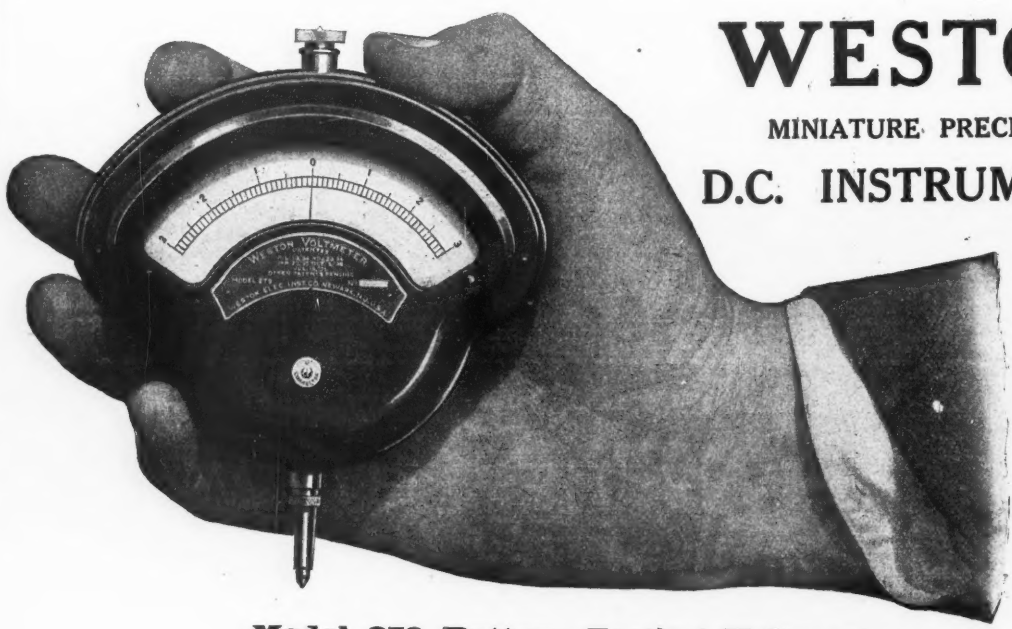

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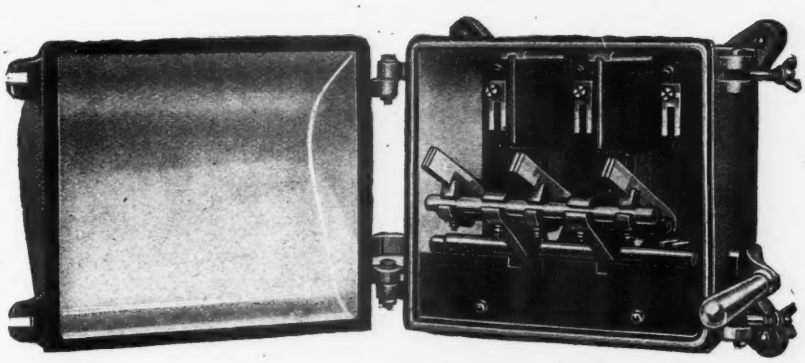

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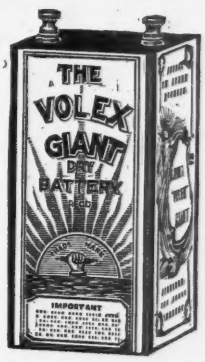

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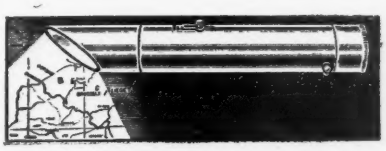

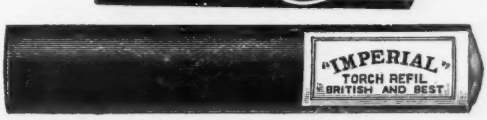

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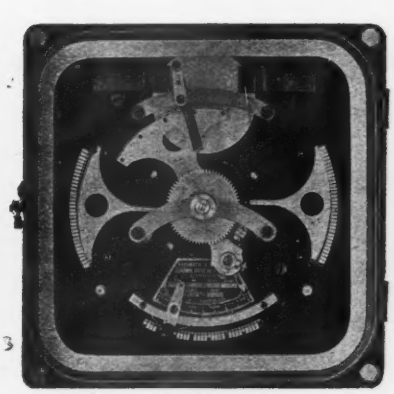

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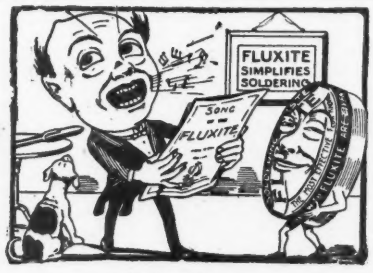

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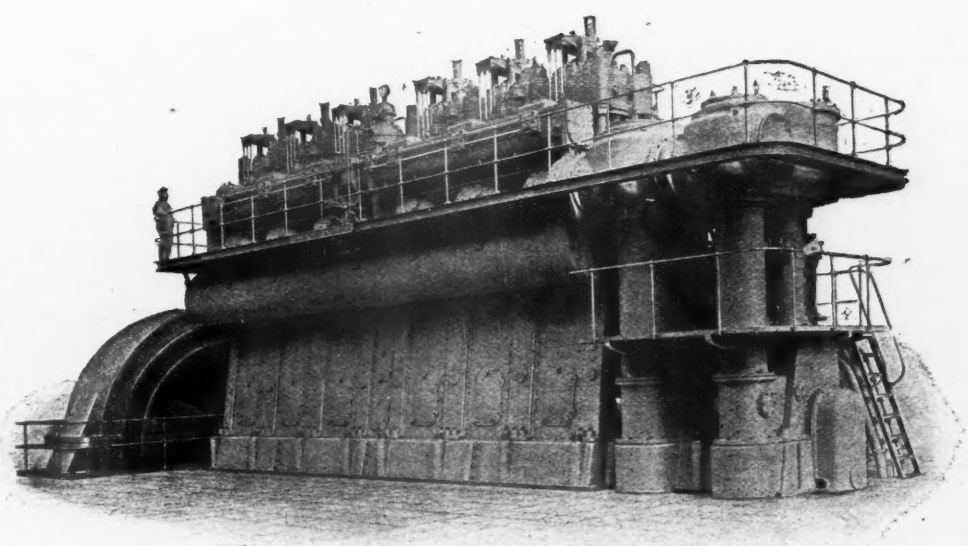

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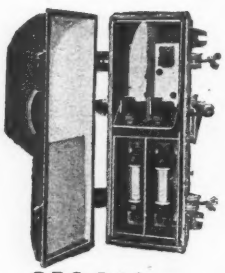

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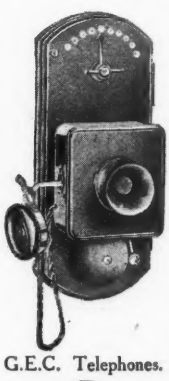

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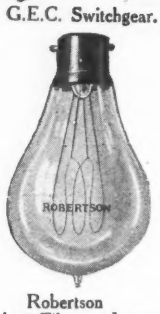

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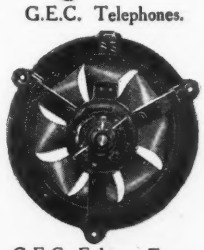

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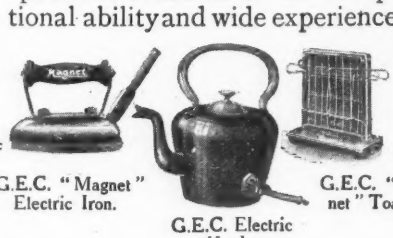

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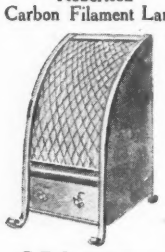

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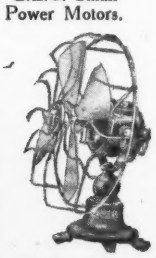

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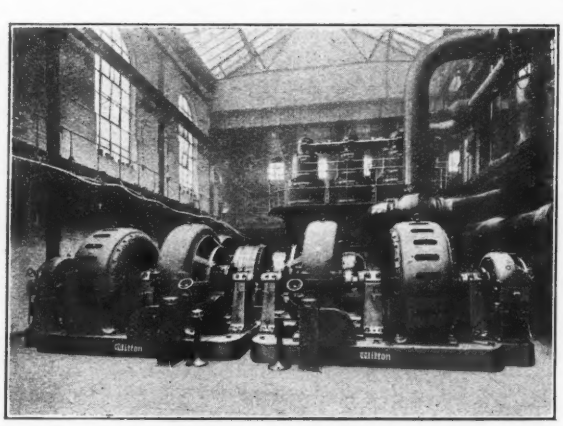

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Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY per Word (minimum 1s.). Box Number and "Electrical Review" Address count as Seven Words.

Three Consecutive Insertions for the Price of Two, if ordered and prepaid with first Insertion.

LATEST TIME FOR RECEIVING 9.30 a.m. THURSDAYS.

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OFFICIAL NOTICES, &c., 1s. per line in Column.

The ELECTRICAL REVIEW is the recognised medium of the Electrical Trades, and has by far the LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

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ELECTRICAL

PARTNERS and PARTNERSHIPS

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WHEATLEY KIRK, PRICE & CO.

(Established 1850).

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By Order of the Directors of Maxwell & Ponting, Ltd.

SALE BY AUCTION, WITHOUT RESERVE,

OF THE

COSTLY TRADE FITTINGS,

INCLUDING

THE ELECTRIC GENERATING PLANT

comprising 60-H.P. Otto Gas Engine; large Electric Dynamo, by Laurence, Scott & Co.; Switchboard, &c., complete and in full working order; installation of Electric Irons; Electric Light Fittings and Cable: 8-H.P. Omnium Motor Delivery Carrier; Telephone Transmitters; Iron Safes; Board Room and Office Furniture; valuable Show cases and other items.

B. NORMAN & SON

WILL SELL THE ABOVE ON THE PREMISES,

121 to 125, WESTBOURNE GROVE, W.,

ON

WEDNESDAY, JANUARY 12th, at ONE.

On View two days prior. Catalogues of the Auctioneers, 1, Gresham Street, London, E.C. Tel. No. 2846 Central. 9913

EDUCATIONAL NOTICES.

Latest time for receiving 9.30 a.m. Thursday.

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AM.I.E.E., A.M.I.C.E., A.M.I.M.E., Matriculation, B.Sc. (Engineering), secured with minimum expense and energy by "U.E.C." Individualised Correspondence Courses. Advice and guidance *free*.—Apply Advisory Secretary, UNIVERSITY ENGINEERING COLLEGE, 3, St. Mark's Crescent, Regent's Park, London, N.W. (Five Advertisements below.) 4281

CORRESPONDENCE Courses in Civil, Electrical, and Mechanical Engineering. Specially *Reduced* Fees during the War! Success *guaranteed!*—UNIVERSITY ENGINEERING COLLEGE. Advertisements above and below.) 4282

ELECTRICAL Engineers desiring *early* advancement will be well advised to send for the "U.E.C." Prospectus, see UNIVERSITY ENGINEERING COLLEGE advertisements, numbered 4281, 4282, 4283, 4284, 4286, *at once!* 4285

EDUCATIONAL NOTICES.—*Continued.*

FREE!! Send *immediately* for "U.E.C." Prospectus of Specialised Engineering, Mathematical and Examination Training. Unique system! Record series of successes.—UNIVERSITY ENGINEERING COLLEGE. (Advertisements above and below.) 4283

MATHEMATICS effectively mastered by the "U.E.C." *practical* Correspondence System. The *most profitable investment* on market. *Commercial Engineering*, Works Management, Installations, Electrical Design, Draughtsmanship, &c.; UNIVERSITY ENGINEERING COLLEGE, advertisements numbered 4281, 4282, 4283, 4284, 4285. 4286

WANTED Engineers—to fill responsible positions in the Trade Boom ahead! *Think!! Are you qualified?*—Let "U.E.C." particularly advise and quote you *free* concerning Course of Spare-Time Training to most profitably develop *your* abilities.—Write now to UNIVERSITY ENGINEERING COLLEGE. (Five Advertisements above.) 4284

SITUATIONS VACANT.

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Original Testimonials should never be sent.

WAR DEPARTMENT.

Military Camps, Southern Command.

ELECTRIC LIGHTING.

THE following Positions are Vacant at Camps near Salisbury:—

Shift Engineers,
Station Fitters,
Wiremen,
Engine Drivers (Steam and Oil Engines).

Unfurnished single quarters can generally be provided.

Preference will be given to applications from men who have been discharged from the Army or Navy, or are not eligible for military service.

Applications, enclosing copies only of testimonials, and stating briefly training, experience and wages required, should be sent to the undersigned at once. Envelopes should be endorsed "Power House Staff."

CHIEF ENGINEER, Southern Command,
Radnor House, Salisbury. 9806

(*Continued on next page.*)

SITUATIONS VACANT.—*Continued.*

CORPORATION OF WAKEFIELD ELECTRICITY DEPARTMENT.

WANTED, two Switchboard Attendants at the Wakefield Corporation Electricity Works. Applicants must already have some experience of the working of a large A.C. switchboard. State salary required. The person engaged will be "on War Service," but no applications are desired from those so engaged at present without the full consent of their employers. Written applications, enclosing copies of testimonials, to be addressed to the CITY ELECTRICAL ENGINEER, Wakefield. 9816

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A BOILER-House Foreman wanted in Corporation power station, experienced in efficiency testing, CO_2 recorders, &c.; required to undertake repairs to boilers and mechanical stokers, and act as reserve fireman on emergency.—Apply stating age, wages required and giving particulars of experience, to 9767, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A CHARGE Engineer is required immediately for Power Station in London district. Must be first-class man, experienced in working of turbines, B. & W. Boilers and E.H.T. supply. Progressive salary for really suitable man.—Apply stating age, salary required, and giving full particulars of experience, technical and scholastic training, and when able to take up duties, to 9784, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winder wanted immediately for re-winding Traction Motors; long hours and high wages for a good man.—MANAGER, Corporation Tramways, Brighton. 9801

BOROUGH of Eccles.—The Electricity Committee require a Shift Engineer (for permanent engagement) in their generating station; wages 40s. per week, rising to 42s. per week at the expiration of six months' approved service; war service badge provided.—Applications endorsed "Shift Engineer," stating age, experience, and when able to commence duty, accompanied by copies of not more than three recent testimonials, to be addressed to the BOROUGH ELECTRICAL ENGINEER, Electricity Works, Cawdor Street, Patricroft, Lancs., and forwarded so as to arrive not later than Wednesday, the 3rd prox. 9817

CHIEF Clerk, capable of taking charge of small clerical staff; must be good at figures and not eligible for army. A progressive appointment.—Full particulars to 4225, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN, good general experience in dynamo design, also in very small high-class machines. State age, salary, &c. Shepherd's Bush district. No person resident more than 10 miles away, or already engaged on Government work, will be engaged.—4269, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAWING Office.—Junior Assistant wanted in large East-London electricity works; good handwriting, some knowledge of card systems and map tracing desirable. Must be ineligible for military service, and not on war work.—Full particulars to 9815, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN required for Factory within 20 miles of London; experienced in power, lighting and repairs. Wages 9d. per hour.—Write, giving experience, &c., to 4238, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, practical, wanted for large motor repair and installation business; test-room experience in motor works desirable. Must be able to trace faults and be conversant with connections of A.C. motors, starters and accessories. Men ineligible for the Army and not on war work preferred.—Full particulars to 9814, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN-Wireman wanted to assist in maintenance of lighting and power plant. Wages 8½d. per hour and an additional allowance of 2s. 6d. weekly.—Applications to the ADMINISTRATOR, Graylingwell War Hospital, Chichester. 4273

ELECTRICIAN-Wiremen, screwed and slip tube, power and light; also good all-round jobbing hand. No person resident more than 10 miles away, or already engaged on Government work, will be engaged.—Apply COLLEY, 51, Great Ormond Street, W.C. 4290

ENGINE-Driver wanted, used to Diesel engines, one accustomed to direct-current, three-wire supply. Wages to start 30s., for 56 hours per week.—Application, stating age, experience and testimonials, to ENGINEER & MANAGER, Electricity Works, Basingstoke. 9808

FITTER wanted, must be accustomed to Water-tube Boilers.—Apply ELECTRIC WORKS, Wigan. 4277

FITTER-Driver required for central station. B.T.H. turbines. Wages 36s., plus 4s. per week for war bonus. Reply giving fittings experience. Man appointed will be classed a munition worker.—Box 419, c/o Messrs. R. F. White & Son, General Advertising Agents, 33, Fleet Street, E.C. 9823

FOREMAN wanted, by a firm of Engineers under Government control in London District, to take charge of a View Room dealing with small electrical parts. Applicant should have had good electrical manufacturing experience and a sound theoretical training. One used to the supervision of both male and female labour preferred. Those already on Government work need not apply.—Write or apply to nearest Board of Trade LABOUR EXCHANGE, mentioning this paper and No. 9771.

REQUIRED at once, a capable Cable Operator, able to instruct, with knowledge of repairing and testing cable instruments; also some electrical knowledge.—Write E. L. C., c/o Horncastle's, 61, Cheapside, E.C. 4258

REQUIRED for Lift Work, capable Electrician for repairs; only men with good references and not on Government work need apply.—Apply your nearest LABOUR EXCHANGE, mentioning this paper and No. A 1214. 9719

REQUIRED immediately for Gold producing Mine, West Africa, two competent Electricians with experience, three-phase installations.—Apply, with copies of testimonials, stating age, experience and salary required, 9803, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SHIFT Engineer wanted in power house, South Wales; War badge granted; wages to start 40s.; A.C. and D.C. supply.—State fully training and experiences and when free, 9802, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SHOWROOM Assistant required for West-End undertaking; ineligible.—9796, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SUB-STATION Attendants of over military age, or who are otherwise ineligible for Naval or military service, wanted temporarily to take the place of men serving with the Forces. Wages £2 per week of 56 hours; overtime at single rates, and in addition 3s. per week war bonus.—Apply, with particulars of past experience, to GENERAL MANAGER, Electricity Offices, Dunning Street, Sunderland. 4203

SWITCHBOARD Attendant wanted at once, Slades Green Electric Light and Power Station (three-wire, D.C.). Knowledge of battery routine, wiring and arc lamps necessary. Average 56 hours weekly. State age, experience and pay required.—Apply, P. C. TEMPEST, S.E. & C. Rly., Tonbridge Station. 4268

TELEPHONE Fitters required; must be thoroughly experienced in intercommunication work; permanency for competent men.—PRIVATE TELEPHONE COMPANY, 28, Great Queen Street, Kingsway. 4239

TEST-Room Assistants required for testing electrical motor control gear of all kinds; also others for testing electrical meters.—Apply nearest LABOUR EXCHANGE, mentioning this paper and No. A. 1087. No person engaged on Government work need apply. 4247

WANTED, an Electrician to take charge of D.C. installation, about 750 KW., for hauling and pumping purposes; must be 6 o'clock man and have had considerable colliery experience and state salary required.—Apply to BOX 56, Wrexham. 9807

WANTED, Car Shed Fitter; preference given to one with a knowledge of B.T.H. equipment.—State wages, &c., to 9810, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Electrician-Wireman, thoroughly experienced.—Write, stating experience and wages required, to BURSTON, SUTTON & CO., 87, Bishopsgate, E.C. 4256

WANTED, competent and experienced Engineer, to take charge of London sales and export department of Electrical Manufacturing Company; similar experience and intimate knowledge of motor control gear and meters desirable.—Apply stating age, qualifications and salary required, to 4248, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED immediately, fully-qualified Electrician to take complete charge of all electrical equipment in large seaplane works on the South Coast. Highest references required. Good rate of pay to suitable man. No man on Government work will be engaged.—Write to your nearest LABOUR EXCHANGE, mentioning this paper and No. 9790.

WIREMEN for Lighting and Power, accustomed to casing and tube; permanency to suitable men.—Apply stating age, married or single, and wage required with copies of testimonials, NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 4216

(*Continued on next page.*)

SITUATIONS VACANT.—*Continued.*

WORKING Resident Engineer wanted for Bargoed district (Glam.) by the Rhymney Valley & General Electric Supply Co., Ltd., to take charge three-phase sub-stations and underground and overhead distribution. Must be good cable jointer with knowledge of transformers, meters, installation work, &c.—Apply by letter, stating age, experience, salary required, to SECRETARY, Prudential Buildings, Cardiff. 9818

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.

ASSOCIATION of Electrical Station Engineers. (Founded January, 1913.) The protective organisation for Electricity Supply Engineers.—Write for particulars and a copy of "A.E.S.E. Progress" to A.E.S.E., 41, Warren Road, Leyton, E. 4275

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SITUATIONS WANTED.

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ADVERTISER, experienced in supervision and manufacture of electric cooking and heating apparatus, installation, plant work, &c., seeks position.—4257, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (41), considerable experience with large firm manufacturing small motors, fans, accessories, &c., seeks position; charge of business and production side of similar department. Excellent references. — 4201, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer, M.I.E.E., Assoc. M.I.C.E., thorough technical qualifications and large commercial experience home and abroad, desires responsible appointment. Tactful and energetic, used to taking initiative and control.—9819, ELECTRICAL REVIEW. 4, Ludgate Hill, London.

ELECTRICAL Construction Engineer (32), home and foreign experience, motors, telephones, arc lamps; disengaged.—GOLDEN, 7, Randolph Gardens, Maida Vale, London. 4211

ELECTRICAL Engineer (married), 20 years' good experience in installation work of every description, last situation as manager of electrical department of old-established business; excellent testimonials.—4263, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, disengaged, Westinghouse trained, 12 years' experience factory and large contracts, theoretical and practical experience in both A.C. and D.C. plant. — 4280, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN (ineligible), married, thoroughly experienced in all branches, requires permanent responsible position; good testimonials for supervision and abilities. — 4264, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, disengaged; light, power, 'phones; would take charge.—W., 2, Montague Road, Hendon, N.W. 4267

ENGINEER-Electrician, charge private plant; wages £3. No cards.—IRELAND, Trulls Hatch, Rotherfield. 4287

ENGINEER-Electrician, Wireman, seeks situation; charge estate or works plant preferred.—BRAY, 146, Finborough Road, Kensington. 4266

ENGINEERING Draughtsman, versed electrical, mechanical and structural design. — 4217, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ESTATE-Engineer, Electrician (40), married (ineligible), seeks appointment; competent man, any plant; 5 years present private situation; highly recommended. — PHILPOT, Oakhurst, Merstham, Surrey. 4288

FITTER'S Mate wants job; used to screwed tube work. Rate 8½d. per hour.—V. J. F., 32, Claremont Square, E.C. 4260

FOREMAN-Electrician, disengaged, seeks appointment, town or country, 20 years' all-round D.C. experience generators, motors, lifts, power distribution, automatic signalling telephones, construction and maintenance. — 4213, ELECTRICAL REVIEW, 4, 4, Ludgate Hill, London.

TWO Electricians capable of taking charge of large Power Plant, Wiring, Motors, Dynamos, Switchboard, used to Suction Gas, also Oil, Town, Gas and Steam, seek situations.—"ELECTRICIAN," 2A, Broad Lane, Tottenham. 4289

SITUATIONS WANTED.—*Continued.*

WIREMAN wants job lighting, power, &c.; excellent refs. Navy discharge. — HOBBS, 117, Tufnell Park Road, Holloway. 4262

WIREMAN wants job; Government work preferred.—E., 10, Faraday Road, North Kensington. 4265

WIREMAN wants job, lighting, power, &c. Excellent references; Army discharge.—CARROL, 7, Winchester Street, Pimlico. 4261

WIREMAN wants job, casing, Simplex, barrel.—HARVEY, 41, Mildmay Street, Mildmay Park, N. 4259

WIREMAN, reliable, wants job; any system; refs.—"B," 63, Blandford Road, Beckenham. 4271

WIREMAN, competent, case or tube; London rate.—F. B., 18, Paddock Gardens, Upper Norwood. 4272

YOUNG Electrician (married), disengaged; all systems, contract or maintenance.—G., 17, Cloudesley Place, Islington. 4276

AGENCIES.

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AGENTS wanted in Colonies, allied and neutral countries, for sale of British-made fittings for half-watt lamps, &c.—9773, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

SPECIAL CASH BARGAINS.

TWO Miles 2/16 Wire, twin twisted, red and black P.R., D.C.C. braided and compounded; 110 yd. coils. £10 mile for quick sale.

Telephone Cabinets.—We hold a large stock of new Cabinets, guaranteed sound-proof, well made and quite new; usually sold at £15 each. Offered at very low prices to clear. State requirements.

Hack-Saw Blades. Starrett make.—Large stock of 12" and upwards. For hand or power. Offered at 55 per cent. off list prices. State requirements.

1 Ampmeter, up to 150 amps.
2 ditto, ditto 120 amps.
1 Voltmeter, reading up to 120 volts.
} Nalder Bros.' make.
In perfect condition. Price 25s. each. Any one sent on approval.

3-H.P. Witton Motor, 200 v., A.C., 1460 revs., 50 periods, single phase, fitted with 7" × 4" pulley, complete with starter and slide rails. Price £15.
Recently taken out of use for larger power.

3-H.P. Motor, 110 v., D.C., fitted with 5" pulley, complete with slide rails and starter, 1250 R.P.M. Electrical Co.'s make. Price £12.

THE LONDON METAL CO., LTD.,
1A, Forest Lane, Stratford, London, E. 4253

FOR SALE.

250-KW. High-class Generator, comprising Enclosed Inverted Compound Engine, by Galloways, 16 in. and 27 in. cylinders, 11 in. stroke, 360 revs., and Mather & Platt 6-pole Generator, compound or shunt wound, 550 volts. Modern first-class job; immediate delivery.

60-H.P. (two) D.C. Motors, by G.E.C., 250 volts, enclosed type.

26-H.P. D.C. Motor, by G.E.C., 250 volts.

30-KW. Brush Generator, Enclosed Inverted Engine and D.C. Multipolar Generator, 500 volts.

THOMAS MITCHELL & SONS, LTD.,
Edgar Street, Bolton. 9747

FOR SALE.

800-KW. Generating Set, D.C. 500 volts; 600-KW. Generating Set, D.C. 500 volts; two Sets Highfield patent reversible Boosters, each set comprising motor, booster and exciter. 175 amps., 0·150 volt, motor, D.C. 500 volts.

Also several Tanks.

Cheap before removal from London.

Particulars on application to JOHN JACKSON & Co., Scotstoun, Glasgow; or ALBERT BAIRD, 195, Clapham Road, London. 9740

(*Continued on next page.*)

FOR SALE.—*Continued.*

FOR SALE.

NEARLY new Hori. Boring and Facing Machine, by the Atlas Engineering Co., with 4-in. boring bar.
Motor-driven Boring Machine, by the Bement Miles Co., with 5-in. self-act boring bar, arranged for Motor drive.
6-ft. arm Universal Radial Drilling Machine, by the Niles Tool Co.
42-in. Morton Drawback Shaping Machine, with quick return motion.
30-in. Vertical Boring and Turning Mill, by Butler.
Double-geared overhanging arm Horizontal Milling Machine, by Kendall & Gent, table 3 ft. 6 in. by 12 in.
No. 12 Lincoln type Milling Machine, by Kempsmith, table 2 ft. 6 in. by 12 in.
Automatic Twist Drill Grinder, up to 2 in. diameter, by Mayer & Schmidt.
"Gisholt" Universal Tool Grinder, fitted with Pump.
Treble-geared Boring and Facing Lathe, by Whitworth, 3 ft. 3 in. faceplate.

CATALOGUE of Stock MACHINERY. 2-3000 LOTS. Free on application. Inspection invited.

THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

FOR SALE.

ELECTRIC 3-phase, 440-volt, 50-period Motors.

One 40-H.P. Open Protected Type, Squirrel cage Motor, to run at 730 R.P.M., complete with one double-width Belt Pulley, 14" × 9", and one set of Slide Rails and Bolts.
One 40-H.P. Totally-enclosed Auto-Starter.

One 10-H.P. Slip-ring Motor, Totally Enclosed, Continuously Rated, speed 730 R.P.M. with free end shaft.
One 10-H.P. Reversing Controller, with 5 contacts on both sides, with phase switching-off arrangement on 2 phases, and with necessary separate resistance.

One 15-H.P. Slip-ring, Open Protected Type, Continuously-rated Motor, speed 730 R.P.M., fitted with back gear shaft through bedplate; having mounted: one machine cut steel reduction gear, ratio 4—1 with back gear shaft fitted, with Pulley 12" × 8" face; complete with one set of Slide Rails and Bolts.
One Protected Type Rotor Starter.

One 15-H.P. Squirrel-cage Motor, Open Protected Type, Continuously Rated, speed 730 R.P.M., fitted with Belt Pulley 12" diameter × 8" face; one set of Rails and Bolts.
One 15-H.P. Auto Transformer Starter.

One 5-H.P. Squirrel-cage, Open Protected Type, Continuously-rated Motor, complete with Belt Pulley 8" diameter × 4½" face; one set of Slide Rails and Bolts.
One Star Delta Starter.

One 40-H.P. Slip-ring Motor, Open Protected Type, 970 R.P.M., free end shaft.
One "Empire" Automatic Controller, by the Electrical Control, Ltd., Glasgow; suitable for 40-H.P., 440-volt, 50-cycle, 3-phase, slip-ring motor, open pattern, complete with one "Empire" pressure regulator to operate between a pressure of 74 to 82 lbs. for air-compressor use.

The above machines are brand new, all continuously rated. We could offer very low prices on application for delivery from stock in our Glasgow Warehouse.

PATERSON & SERVICE,
Engineers and Merchants,
38, Bath Street, Glasgow. 9743

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ALTERNATORS for Sale.—The Lancashire Dynamo and Motor Co., Ltd., size 8½, one phase, 33⅓ periods per second, 400 volts, 40 amps., 1000 revolutions per minute, No. 11,224. Helios Elektricitäts Aktiengesellschaft, Koln Ehrenfeld, 6 KW., 1500 revs., 300 volts, 20 amps.; also two Switchboards.—Apply JOHN DEWSBURY & SON, LTD., Littleton Street, Walsall. 4188

FOR SALE.—*Continued.*

ARC Lamp Carbons for Sale; open, enclosed and flame; all sizes, ex stock.—M. O. HECKELS, 4, Northumberland Street, Newcastle-on-Tyne. 9283

DIRECT-Current Generating Sets.—One 50-KW. and two 100-KW., 250 volts; one 120, one 140 and two 260-KW., 500 volts. All enclosed high-speed engines and multipolar generators.—PHŒNIX ELECTRICAL CO., 40, Broomielaw, Glasgow. 9762

DIRECT-Current Motors: 40, 80 and 100 H.P., 230 volts; 110, 130, 150 and 450 H.P., 460—500 volts.—PHŒNIX ELECTRICAL CO., 40, Broomielaw, Glasgow. 9764

DYNAMOS, 3000, 1500, 1000 and 750 amperes at 6 volts, ready for delivery; also smaller sizes delivered from stock. Machines let out on hire.—CANNING & CO., Electro-Platers' Engineers, Birmingham. 7769

ELECTRIC Motors and Dynamos, Sale or Hire. Always a large stock of nearly new guaranteed machines. Immediate delivery.—ELECTRO-GENERATOR CO., 1A, Shepherd's Bush Road, W. 'Phone: 488 Hammersmith. 4194

ELECTRIC Motors (50) for Sale, 440/500 volts, D.C.; cheap. 'Phone: East Ham 693.—SUGDEN, Wakering Road, Barking. 4274

ELECTRIC Pulley Blocks for Sale; Three 1½-ton 200/250-volt Electric Pulley Blocks, first-class condition, complete, ready for immediate delivery. Particulars on application.—4229, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, three-line Compound Engine direct coupled to Multipolar D.C. Generator, both by Allens, of Bedford; steam pressure 160 lbs., voltage 460-560. In excellent condition and can be seen running at municipal power station in Midlands. Reason for disposal being too small for practical use in largely-extended power house.—9821, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, two Allen's Compound Engines, each 116 H.P., cyls. 11" and 15" × 7" stroke, direct-coupled to Allen's compound wound 4-pole 70 KW. D.C.; Generators 110 volts, 636 amps. One Willans & Robinson's 3-crank Compound Central Valve Engine, 570 H.P., 300 R.P.M., direct-coupled to 3-phase Westinghouse Alternator, 2,200 volts, 25 periods.—R. H. LONGBOTHAM & CO., LTD., Wakefield. 9625

FOR Sale, 12-in. Centrifugal Pump, coupled direct to 60-B.H.P. Motor, 500 volts, 32-ft. head, 2,300 gal. per min. 14-in. ditto, coupled to vertical high-speed Engine, 32-ft. head, 2,650 gal. per min.—R. H. LONGBOTHAM & CO., LTD., Wakefield. 9643

FOR Sale.—370-KW. Steam Generating Set, 460—550 volts, D.C., can be seen fixed working.—WILLIAMS, 37, Queen Victoria Street, London, E.C. 9799

FOR Sale.—150-KW. Compound Enclosed Engine, with Siemens Dynamo, 500 volts, continuous current, compound multipolar machine; can be seen fixed.—WILLIAMS, 37, Queen Victoria Street, London, E.C. 9800

FOR Sale, three-phase Alternator, 240-KW. at ·85 power factor, at voltages between phases 2200, at 40 cycles; in excellent condition.—R. H. LONGBOTHAM & CO., LTD., Wakefield. 9254

FOR Sale, 240-KW. Generating Set, comprising three-crank Vertical Compound Engine, direct-coupled with three-phase alternator, 2200 volts, 40 cycles, up-to-date and in excellent condition.—R. H. LONGBOTHAM & CO., LTD., Wakefield. 9255

FOR Sale or Hire, high-class Dynamos, Motors, Alternators, Cable and Arc Lamps.—PERCY HUDDLESTON & CO., 72, Finsbury Pavement, E.C. 3203

FOR Sale.—One Turbo-Alternator, 1,000 KW., 50 cycles, 1,500 R.P.M., voltage 6,600, with Condenser and Edwards Air Pump.—R. H. LONGBOTHAM & CO., LTD., Wakefield. 8164

FOR Sale, one Willans & Robinson Three-crank Compound Central Valve Engines, 570 H.P., 300 revs., direct coupled to three-phase Westinghouse Alternator, 2,200 volts, 25 periods. Two Allen's Compound Engines, 116 H.P., 390 revs., cyls. 11 in. and 15 in. × 7 in. stroke, direct coupled to Allen's Compound-wound 4-pole 70-KW. D.C. Generators, 110 volts, 636 amps.—R. H. LONGBOTHAM & CO., LTD., Wakefield. 9418

FOR Sale.—43-KW. Generating Set, 500 volts, D.C.; 18-H.P. Motor and Turbine Pump for 12,000 gals. per hour, 550 volts, D.C.—RHYS HARRY, Llanelly. 4200

FOR Sale.—Four second-hand Excello pattern MUN 8-ampere 100-cycle Arc Lamps and choking coils, 700 pairs white carbons.—TAYLOR, Macaulay Street, Huddersfield. 4246

FOR Sale, a bargain, six Wall and six Desk Pattern Ericsson Intercommunication Battery Ringing 'Phones, metallic circuits, and about 220 yds. 15 double-way cable.—HUBBER & SON, South Street, Exeter. 4189

(*Continued on next page.*)

FOR SALE.—*Continued.*

FOR Sale, one 100-H.P. 500-volt, 550-R.P.M. shunt-wound Motor; one 10-H.P. 220-volt, 1200-R.P.M. compound-wound Motor. Arc Lamp Carbons, enclosed, open and flame, all sizes in stock.—4250, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GENERATING Sets:—One Willans-B.T.H., 325 KW., 230 volts; one Belliss, 275 KW., 500 volts; one Belliss, 160 KW., 240 volts; one Willans, 160 KW., 220 volts; one Willans, 60 KW., 220 volts; one Willans, 50 KW., 220 volts. D.C. Motors from 2/30 H.P., A.C. Motors 10/15 H.P.—JENNINGS, West Walls, Newcastle-on-Tyne. 5939

HIGH speed Enclosed Engine, by Browett, Lindley & Co., cyls. 8½ in. and 14 in. × 8 in. stroke, forced lubrication for coupling to generator.—Apply HARRY H. GARDAM & CO., LTD., Staines. 9217

METAL Filament Lamps, by renowned British Manufacturer; large quantity of 100 volts to 125 volts, 16 to 100 candle-power. Perfect delivery guaranteed. Cheap and good. — 3957, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MOTOR, A.C., 83 cycles, ¼ H.P. (new).—GRAHAM & LATHAM, LTD., 104, Victoria Street, S.W. 4255

MOTORS.—One 10-H.P., 230-volt, protected type, shunt wound, 900 R.P.M.; one 12½-H.P., 230-volt, 680 R.P.M., shunt wound; one 20-H.P., 230-volt, 730 R.P.M., complete with Pulleys, Slide Rails, Starter, &c.—9812, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

THREE-Phase Motors:—7½, 12, 15, 17 and 20 H.P., 220 volts; 12, 15, 20, 60 and 150 H.P., 440 volts; 25, 50, 75, 100 and 300 H.P., 500 volts; all 50 periods.—PHŒNIX ELECTRICAL CO. 40, Broomielaw, Glasgow. 9763

THREE-Phase Plant for Sale.—Two 500-KW., 500-volt, Turbo-Generators, complete with condensing plant, switchboard, &c.; One 400-KW., ditto, but with H.S. Reciprocating Engine; also 100 and 140 KW. belt-driven Alternators. All 50 periods.—PHŒNIX ELECTRICAL CO., 40, Broomielaw, Glasgow. 9761

TO be Sold, Five Electric Motors, 440 V., D.C., low speed, 30, 30, 10, 6 and 2-H.P., complete with amp.-meter, switches, fuse-box, starter; all about new.—Apply by letter, VICTOR BRUYNEIL, 45, Horseferry Road, Westminster, London, S.W. 4270

TURBO-Alternator Set, comprising 1000-H.P. Willans Turbine, coupled to 750-KW. Siemens Alternator, 440 volts, three-phase, with surface condensing plant, Edwards air pumps, &c. In use for a short time only.—Apply HARRY H. GARDAM & CO., LTD., Staines. 8892

TWO 80-KW. Generating Sets, comprising high-speed Engine, coupled to B.T.H. Generator, 460 volts D.C., for immediate sale and delivery from stock.—HARRY H. GARDAM & CO., LTD., Staines. 9680

5-KW. Testing Set, 100 volts, D.C., to 100/2,000 volts A.C., including rotary converter, transformer, switchboard. Also about 30 Crompton enclosed Arc Lamps, with workshop lanterns, 100 volts, 5 amperes.—Apply ALFRED GRAHAM & CO., St. Andrew's Works, Crofton Park, London, S.E. 9779

10-KW. Motor-Generator, by E.C.C., Wolverhampton; done two months' work only; 460 to 230 volts D.C.—HARRY H. GARDAM & CO., LTD., Staines. 9624

30-H.P. and 10-H.P., series-wound, 220-volt Motors; three 45-H.P., 220-volt, shunt-wound Motors; Tangye Radial Drilling Machine, 3-ft. 6-in. arm; Steam and Electric Pumps; two Generating Sets, 110 volts.—MARTINS, 320, Witton Road, Birmingham. 4222

87-KW., 220-volt, six-pole shunt Generator, 500 revs., suit belt or direct drive; two years old, but as new.—DRUMMOND AND CO., Commercial Street, Middlesbrough. 4221

150-KW. 500-volt Generating Set for Sale, Belliss engine. Seen at work by appointment. Price £600. — 4241, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

180-B.H.P. Gas Engine, by the National Gas Engine Co., Ltd., No. 22,607, has done two months' work only, and for every practical purpose is equal to new.—HARRY H. GARDAM & CO., LTD., Staines. 9681

200-KW. Generating Set, Belliss & Morcom three-crank six-cylinder Engine, coupled direct to Parker Dynamo, 210 volts, 900 amps., 420 revs., Switchboard and new spare Armature. Seen fixed in London for next few days.—JOSEPH PUGSLEY, 72, Queen's Circus, Battersea Park, London, S.W. 4196

200-KW. 10-pole Generator, by Sandycroft, 220 volts, D.C., 150 R.P.M., modern and first-class machine.—HARRY H. GARDAM & CO., LTD., Staines. 9578

300-KW. Alternator, by Brush Electric Co., 6500 volts, three-phase, 50 cycles; was supplied new in 1912 and has done very little work indeed. In stock.—Apply HARRY H. GARDAM AND CO., LTD., Staines. 9268

ARTICLES WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
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ACCUMULATORS wanted for refining purposes. Obsolete Generating Sets, Dynamos, Motors, and all kinds of Machinery. Scrap Cable, Arc Lamps, Meters, Metal Residues, and Scrap Metals of every description purchased for prompt cash, town or country.—Apply A. BROWN & SONS, 142, Lower Clapton Road, London, N.E. Telephone, Dalston, 555. Telegrams, Secondhand, Lowclap, London. Established 1860. 2585

A. LEAROYD & Son, Bridge Works, Clapton, N.E.—Telephone: Dalston 2278; Telegrams: Frangible, Lowclap, London—buys for prompt cash every description of second-hand Generating Sets, Accumulators, Motors, Transformers, old Arc Lamps, Meters, Cable, Scrap Metals, Metallic Drosses, &c. &c. Enquiries solicited. Established over 50 years. 4001

A.C. and D.C. Motors (second-hand) any type, any condition, wanted for prompt cash.—A. LEAROYD & SON, Bridge Works, Heatherley Street, Clapton, N.E. 4002

ALL kinds of disused Plant, Machinery, Scrap Metals, &c., purchased for cash. If you have any Generating Sets, Motor, Dynamos, Steam Engines, Boilers, &c., you wish to dispose of, kindly offer same to us. Complete works purchased for dismantling.—HARRY H. GARDAM & Co., LTD., Staines. Telephone, Staines 98. 8579

ELECTRIC Motors, surplus stock, or good second-hand, wanted for cash. — 4193, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GAS Engine (Second-hand) required, 300 to 500 B.H.P., on producer gas.—Apply, giving full particulars, to 9811, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OLD Electric Lamp Tops, any make, purchased. Any quantities for prompt cash per return; top price given. Sell your goods direct to the original buyers. We pay £9 15s. per oz. for scrap platinum in large or small quantities. We also extract platinum from any metal and pay the above price. Highest cash value paid for disused artificial teeth, old gold, silver and jewellery in any condition; parcels received by post. Prompt cash per return. Mercury bought. We are buyers of all kinds of old metals, aluminium, brass, copper, pewter, lead, zinc and old cables. We pay carriage by goods train. Cash returned immediately as goods received. Inquiries solicited.—J. LEE & Co., Metal and Rubber Merchants, 56, Green Street, Bethnal Green, London. 4251

ONE Electric 10-ton Derrick Crane, 500 voltage D.C., second-hand, in good condition. State price delivered f.o.r., and where seen.—"ELECTRIC," William Porteous & Co., Glasgow. 4291

PLATINUM in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London.

WANTED for quick delivery, a direct-coupled Steam Dynamo, D.C., 75 kilowatts capacity. Engine, non-condensing, suitable for 100 lb. steam pressure. Generator, shunt wound, 220 to 230 volts. A second-hand set, if in good condition, would be suitable. Offers to state price, earliest delivery, age of plant, where it may be seen, and name of makers of engine and generator, number and size of engine cylinders, stroke, speed of revolution; also particulars of generator.—9809, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, 50 ft. or less ⅜-in. "Stabilit" Rod or near larger size.—WILSON APPARATUS Co., Hendon, N.W. 4254

WANTED, Generating Sets, all sizes, Boilers, Accumulators, Dynamos, &c., for export; also Scrap Cable and Metals. Complete plants purchased.—WILLIAMS & SONS, 37, Queen Victoria Street, London. Telephone, 3938 City. 7000

WANTED, anything up to three tons of high conductivity Copper Strip, section 1" × ¼". Offers to 9820, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, 60 to 70-KW. Compound Generator, 230 volts, belt-drive; must be in good order for war work.—9822, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Lancashire boiler; 80-KW., 220-volt Generating Set and two 50-H.P., 460-volt Motors.—MARTINS, 320, Witton Road, Birmingham. 4061

(*Continued on next page.*)

ARTICLES WANTED.—*Continued.*

WANTED, Gas Engine direct coupled to D.C. shunt-wound 20-KW. dynamo, 250 volts maximum for town's gas (550 B.TH.U.).—Full particulars and maker's name and number to J. W. GIBSON, Engineer and Manager, Gas and Electricity Works, Holsworthy, Devon. 4235

WANTED, 150 to 200-KW., 220-volt, D.C. Generating Plant. Alternative offers of engine and generator separately will be considered, but must be modern and price should accompany offer. —9579, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

2-HORSE direct 200-volt Motor.— Price and full particulars, GOLDSTON, Northampton. 4252

WORKSHOPS, PREMISES AND SITES TO LET OR WANTED.

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ELECTRICAL Engineer in South Wales will place at the disposal of Manufacturers or others Shop and Window in main thoroughfare, established 1887, for the sale of Electrical Fittings, Glassware, Novelties, if satisfactory terms can be arranged. —4279, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MISCELLANEOUS.

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A BOON to every user of electricity.—A new British industry, economy in electric lighting, a great saving in the cost of metallic filament lamps by our patented process. We are now prepared to undertake the repair of burnt-out lamps, and large consumers should write for particulars, &c., THE ALLIES ELECTRIC LAMP REPAIRING CO., LTD., Montgomery Street, Hammersmith, W. 4227

ARMATURE Winding, Field Coils, Bearings, General Motor Repairs.—H. DUNN & SON, 32, Newington Causeway, S.E. 4278

WAR Munitions.—Engineers who are prepared to take on Lathe Repetition work at their own Factory please communicate with 4224, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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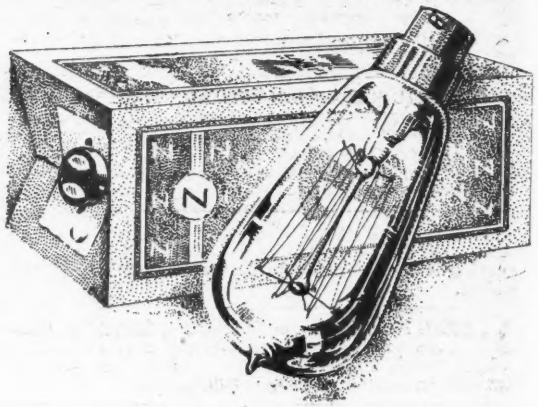
NOTICE.

OWING to the many hundreds of replies passing through this Office each week, we would ask those answering Advertisements to be EXTREMELY ACCURATE with regard to the figures WHEN ADDRESSING REPLIES to Box Numbers.



The Signs of Quality.

EVEN the most casual glance at a "Z" Drawn Wire Lamp will show you that every care is taken in manufacture. The well-finished cap is set on straight, the glass stem is properly centred, and the filament is anchored so that it cannot become detached from the hooks. Compare one of the

"Z"

Drawn Wire Lamps

with any of the cheap Continental lamps, and you will see wherein the difference lies, and understand why "Z's" are used by H.M. Government, municipalities, railways, and other large consumers who carry out exhaustive tests *before* placing their contracts. "Z" Drawn Wire Lamps have a ready sale, and yield a good profit. List and terms post free.

Sole Makers:
THE "Z" ELECTRIC LAMP MFG. CO., LTD.
Offices and Works:
Standen Road, Southfields, London, S.W.

Depots:
BIRMINGHAM: 8, CHURCH STREET, COLMORE ROW.
SHEFFIELD: 19, DOVEDALE ROAD.

Wholesale Agents:
VERITY, LTD., 31, KING STREET, COVENT GARDEN, LONDON, W.C., AND ALL DEPOTS.
SLOAN ELECTRICAL CO., LTD., 12, GOLDEN LANE, E.C., AND MANCHESTER.
BAXTER & CAUNTER, LTD., 219, TOTTENHAM COURT ROAD, LONDON, W.

E.L.H.

This talk of War Economy applies to you—

IT isn't only necessary that you economise in the little luxuries of your private life. Economy in your trade buying is just as vital.

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For your next Installation specify

ARMORDUCT

The Quality Conduit,

You will then effect practical economy in Cost, Time and Labour. There are no annoying "after-faults" with Armorduct. It is installed rapidly, with no excessive labour charges, and is steadily reliable under almost all conditions.

◆

THINK IT OVER!

◆

The

ARMORDUCT

Manufacturing Company, Ltd.,

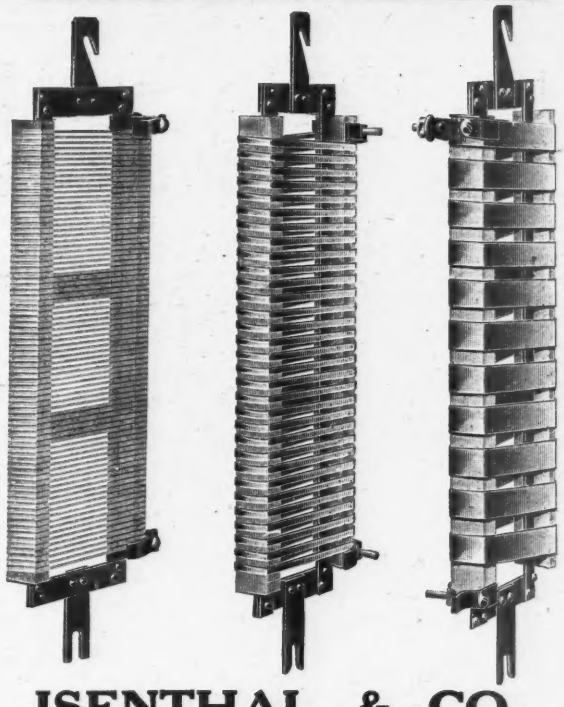
Farringdon Avenue, LONDON, E.C.

Works:

Bathurst Works, Witton, near Birmingham.

RHEOSTATS

NEW LIST IN THE PRESS.



ISENTHAL & CO.,

(DEPARTMENT 3).

Denzil Works, Neasden, London, N.W.

Contractors to the Admiralty, War Office, India Office, Colonial Office, Postmaster-General, &c.

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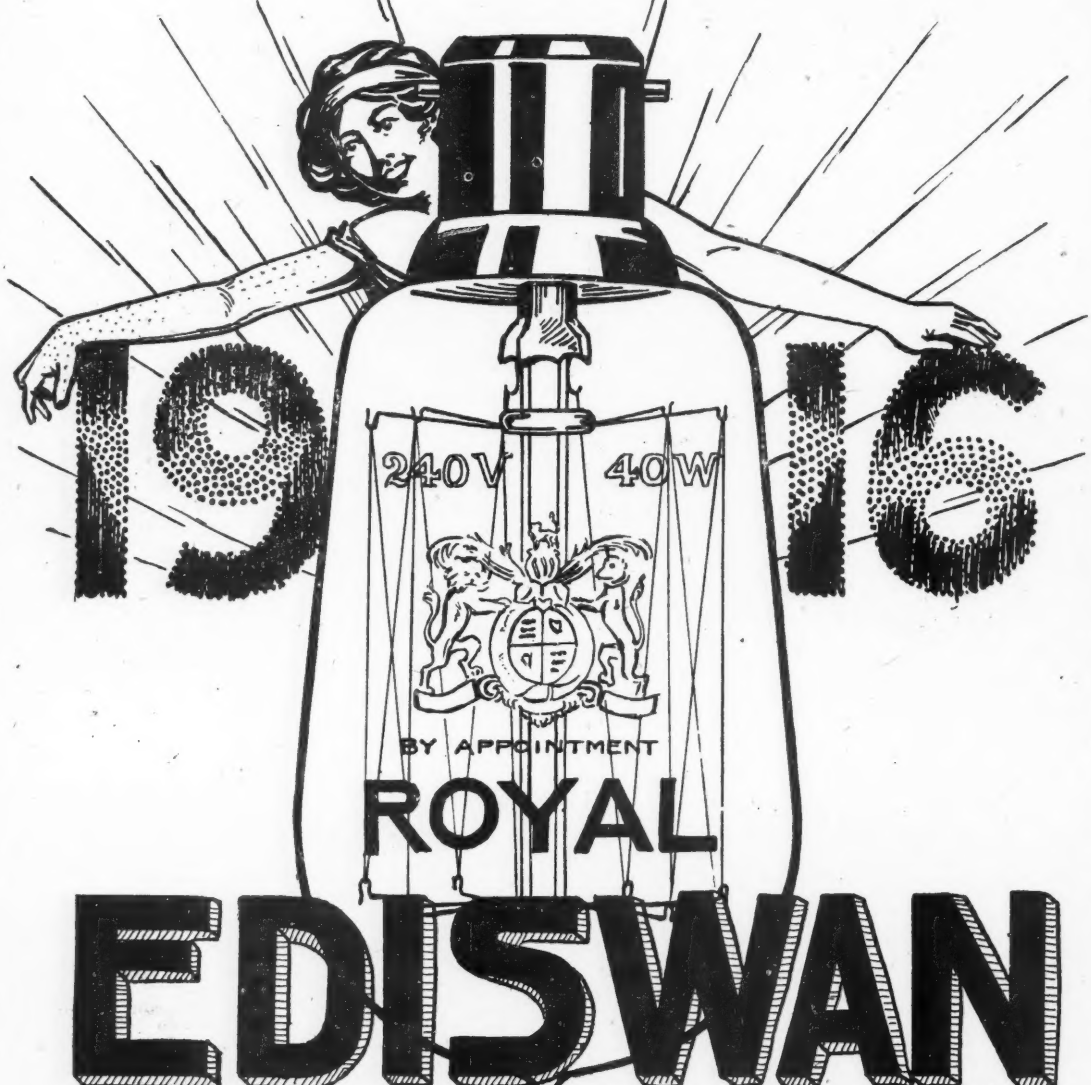
BY INCREASING BUSINESS WITH



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EDISWAN

DRAWN - WIRE - LAMPS

FULL PARTICULARS FROM—

THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.,

Telephone: 520 Enfield. PONDER'S END, MIDDLESEX.

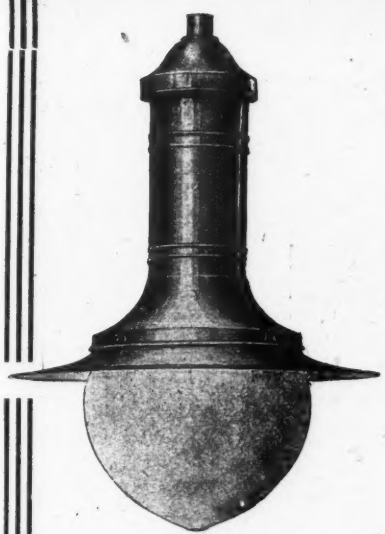
FULLY LICENSED UNDER BRITISH PATENTS NOS 21313/06 27712/03 AND OTHERS

SIEMENS

Weatherproof Lanterns

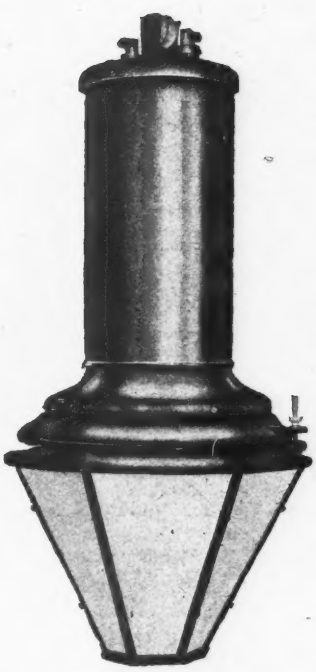
for use with

Half-Watt Lamps.



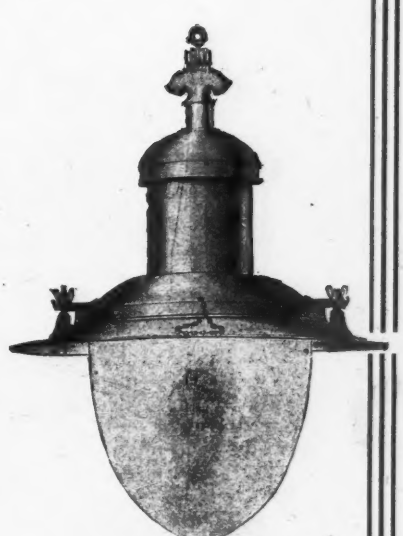
D 5985.
Hard Stove Enamelled Black Iron with Opalescent Globe.
For one Half-Watt Lamp.
300—1000 Watts.

D 5977.
Green and Gold Vitreous Enamelled Iron with Diagonal Half-Opal Globe.
For one Half-Watt Lamp.
300—500 Watts



D 6113.
Complete with Lantern (Opalescent or Frosted Panes).
For one Half-Watt Lamp.
200—1000 Watts.
This fitting can be supplied with internal cut-out and substitutional resistance if required.

D 5969.
Polished Copper with ½-in. iron female nipple and opalescent globe.
For one Half-Watt Lamp.
300—500 Watts.



D 5989.
Stove Enamelled Iron with Opalescent Globe. Complete with G.E.S. Porcelain Holder and Insulated Shackle Suspension.
For one Half-Watt Lamp.
300—1500 Watts.

We illustrate a selection of Weatherproof Lanterns which are specially constructed to carry Half-Watt Lamps. These Fittings are exceptionally well ventilated, of efficient construction and permanent finish. For installations such as FACTORIES, WORKSHOPS, PIT HEADS, &c., they are proving most satisfactory.

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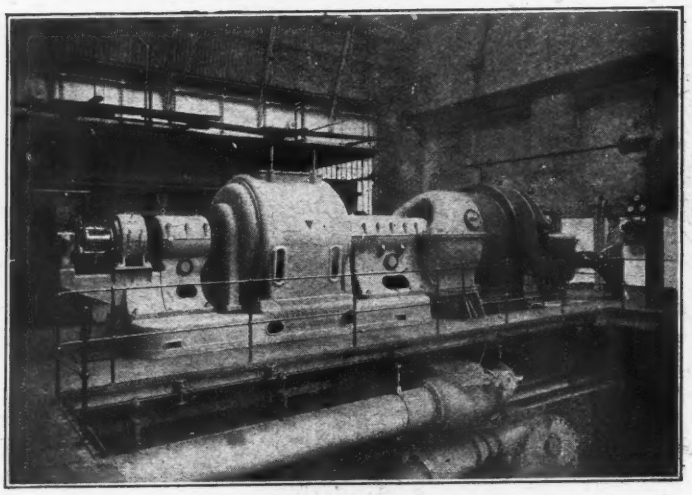
SIEMENS BROTHERS DYNAMO WORKS, LIMITED, 38 & 39, Upper Thames Street, E.C.

VICKERS LIMITED.

Motors and Generators of all Types.

Rotary Converters.

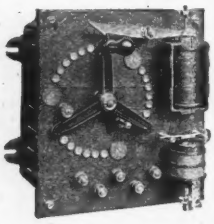
Complete equipment for the electrical lighting and driving of Machine Shops, Factories, Mills, &c.



Three phase Willans-Vickers Turbo Alternator, 3,000 K.W. 1,500 r.p.m., 50 cycles.

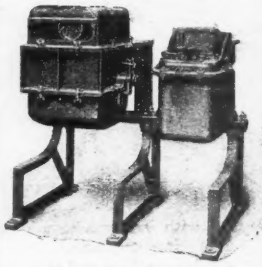
Patent Automatic Reversing Drive for Machine Tools.

River Don Works.
Sheffield.



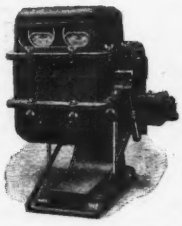
Double Automatic Air-Break Starter.

Air-Break Drum-Type Starting Switch.

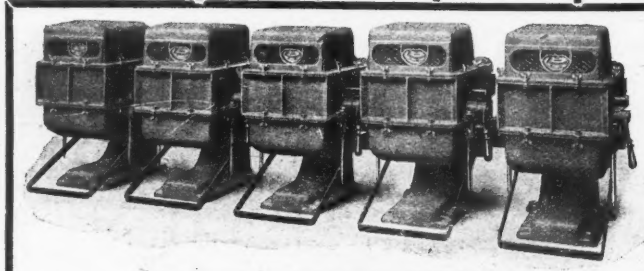


Ironclad Oil-immersed Motor Control Unit.

Oil-immersed Starter.



Oil-immersed Switch Pillar.



Main Distribution Board for Five-Feeder Circuits.

By adopting E.A.C. Alternating-Current Apparatus you will obtain one standard make of Switch and Motor-Control Gear right through your installation from main distribution board down to each motor control equipment.

The E.A.C. Drum-Type A.C. Motor Control Gear possesses several novel features which will be of interest to all installation engineers.

We will send full particulars on request.

THE ELECTRICAL APPARATUS CO., LTD.,

Vauxhall Works,
South Lambeth Road,
LONDON S.W.

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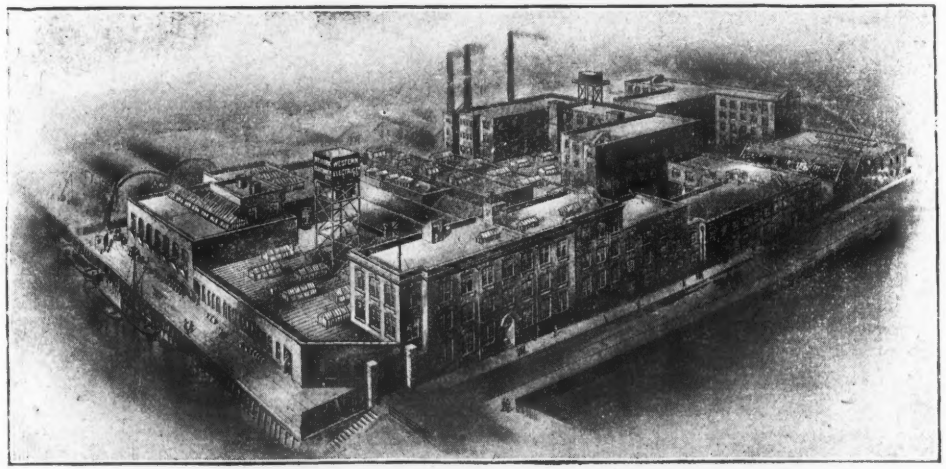

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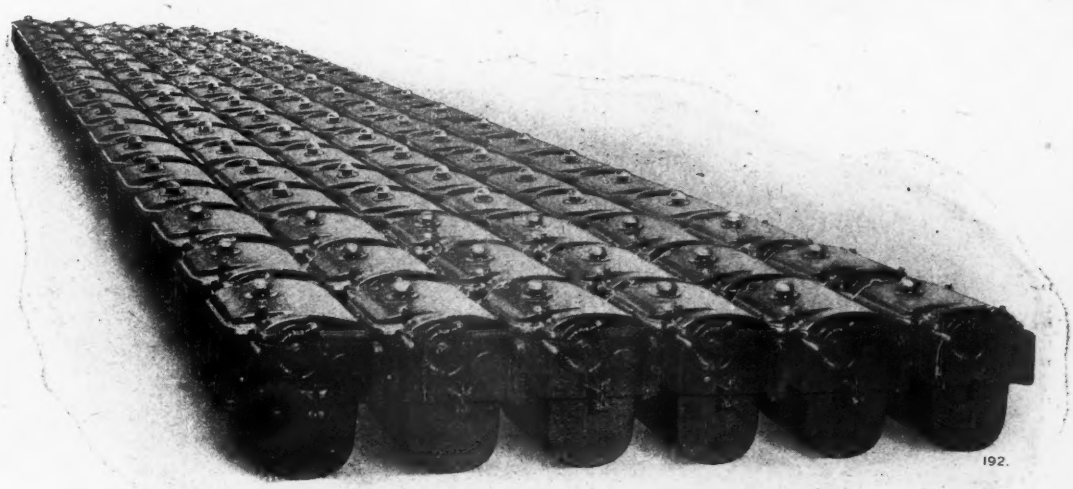

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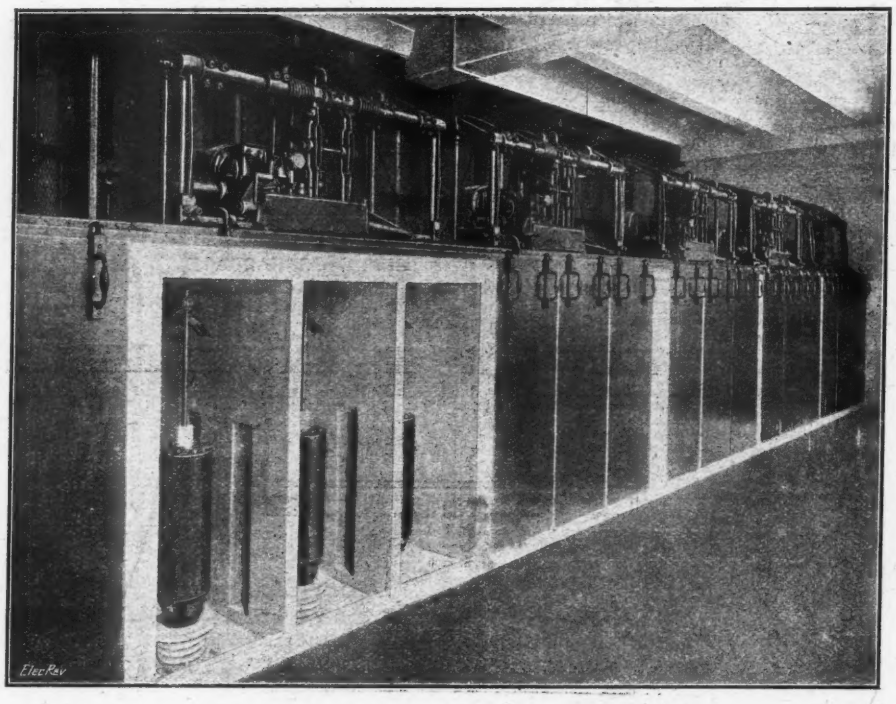

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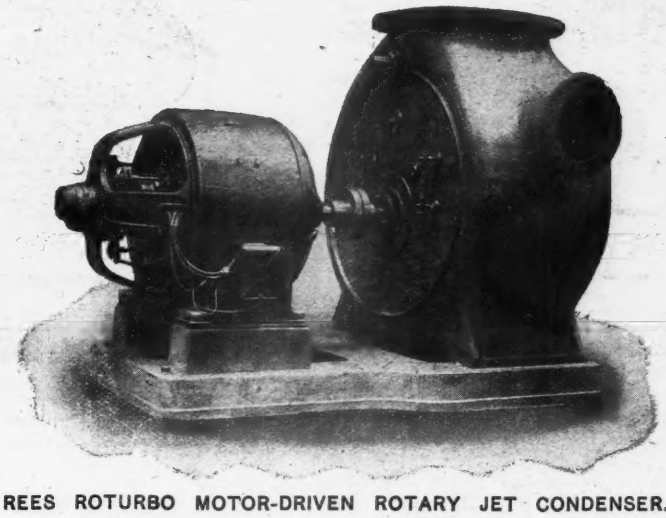

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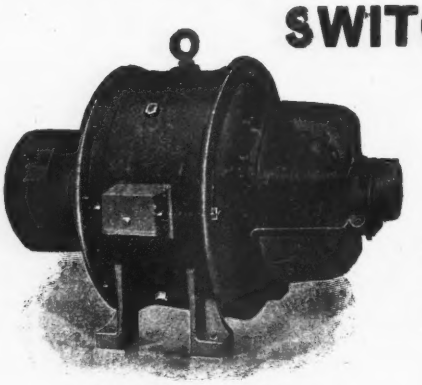

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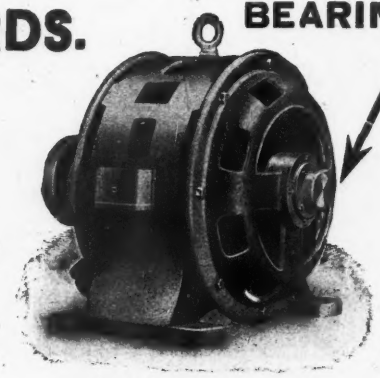

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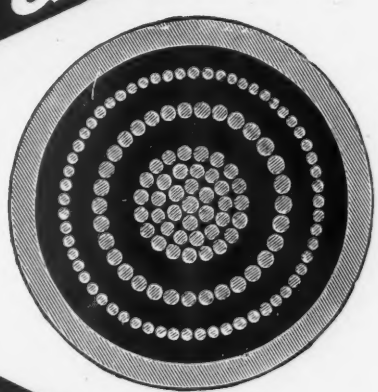

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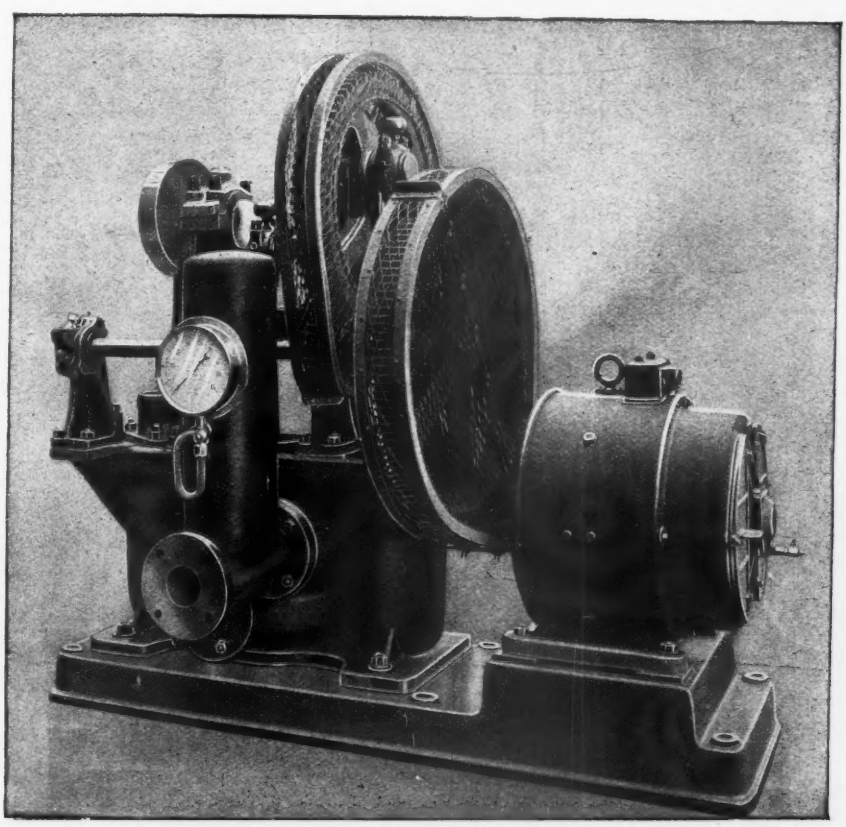

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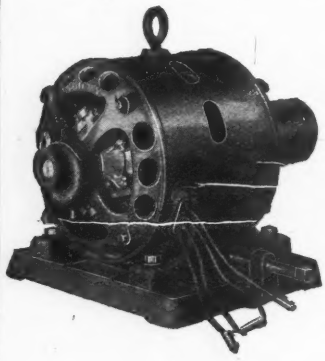

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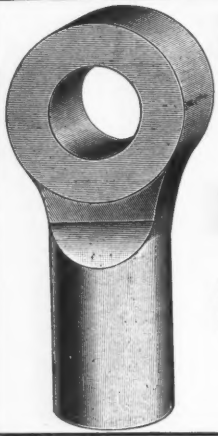

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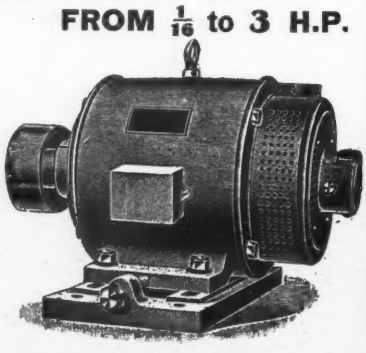

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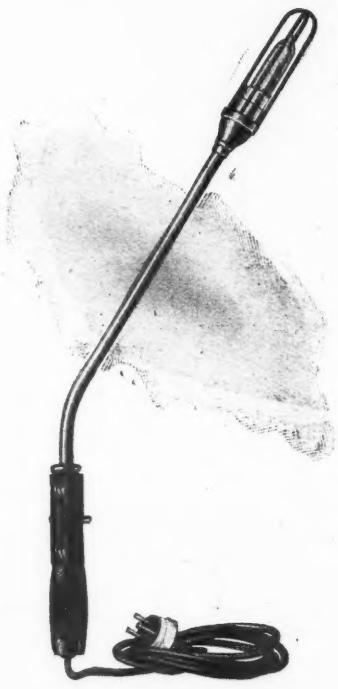

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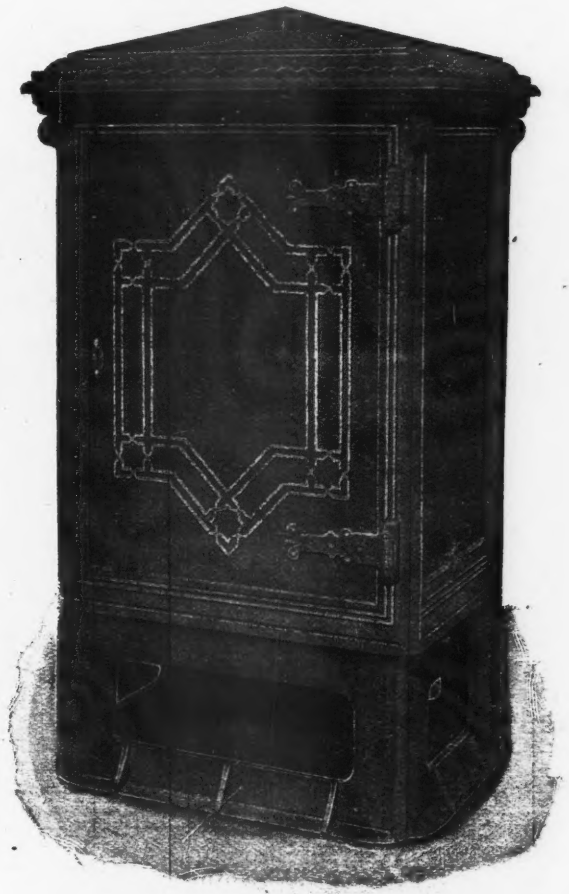

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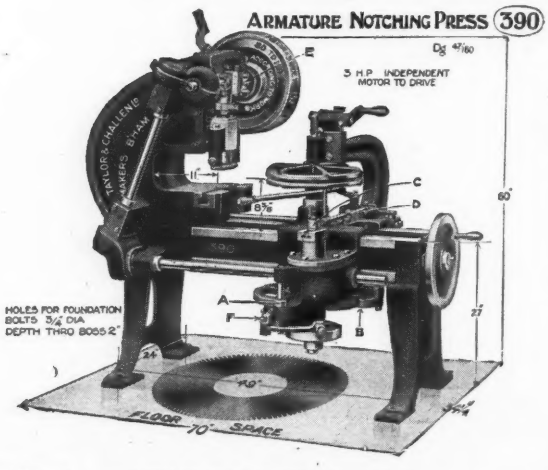
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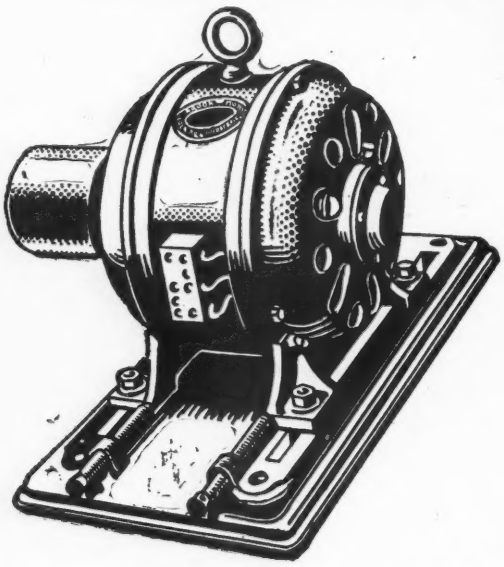

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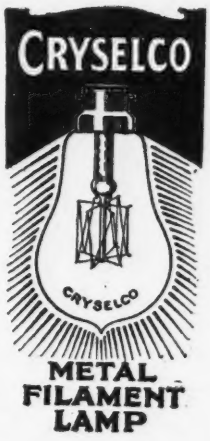

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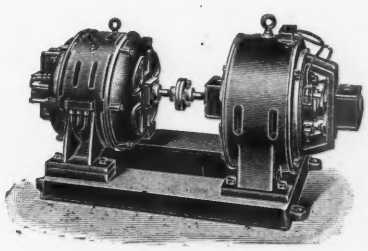

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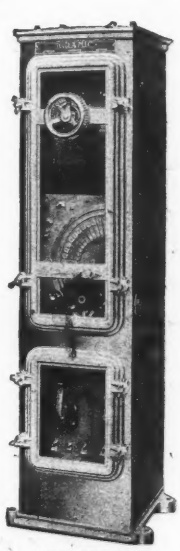

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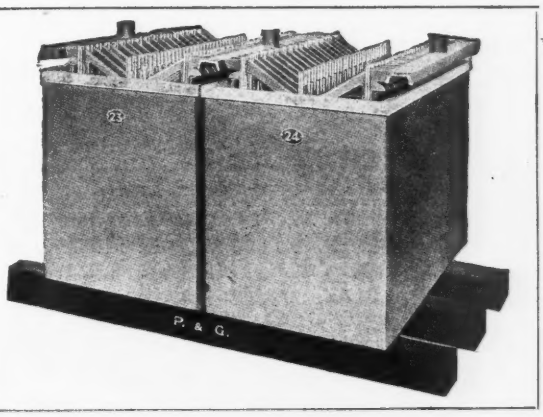

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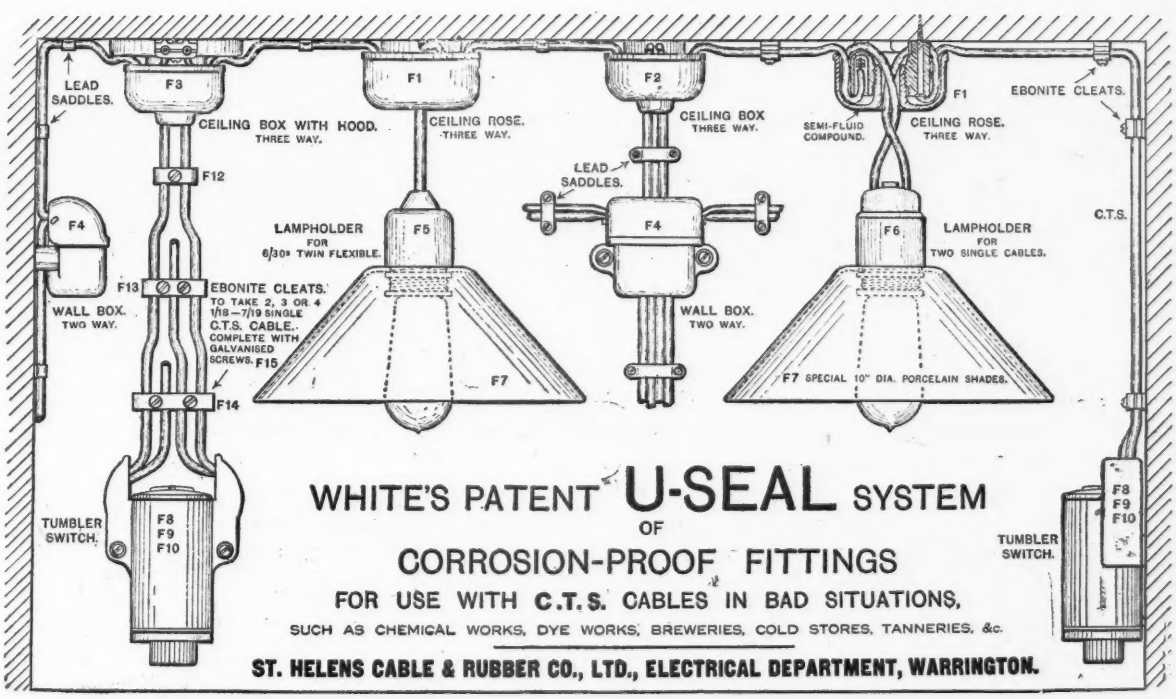

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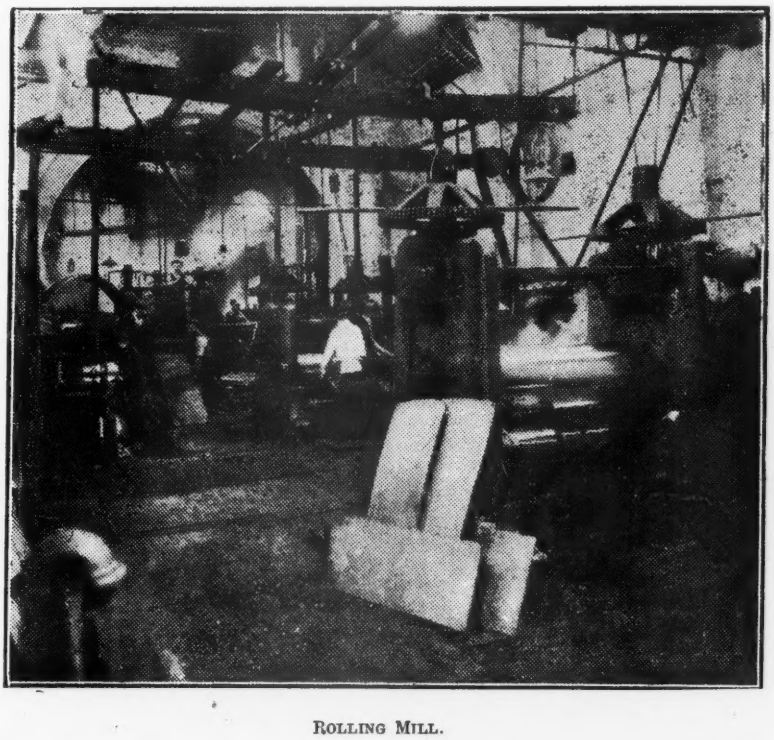

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CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERDARE.—Alteration, "Welsh Harp," Commercial Street; T. Roderick, architect, Ashbrook House.

ACCRINGTON.—New Church at Spread Eagle; Trustees. Primitive Methodist Church in Whalley Road; Trustees.

ALTRINCHAM.—Housing scheme; Surveyor to U.D.C.

ATHERTON.—Garage, for Lee Spinning Co., Ltd.

BACUP.—Rebuilding part of Throstle Mill, for J. Maden & Son, Ltd., cotton spinners.

BARNSLEY.—Garage at 36, Pitt Street, for Dr. Sheridan. Extension of workshop at May Terrace, for M. E. Tune. Two dwelling-houses in Locke Avenue, for F. Ward. Additions to shop, for Barnsley British Co-operative Society.

BATLEY.—Garage at Henry Street, Batley Carr, for J. Fenton & Sons, Ltd. Generator house at Lady Ann Mills, for J. B. & W. Hirst.

BIRMINGHAM.—Factory; Buckland & Farmer, architects, Norwich Chambers. Premises (£4,000), for Taylor & Challen, engineers; T. Elvins, builder, Naden Road.

BRADFORD.—Reconstruction of Prospect Cottage, Allerton, as a branch library and reading room; the City Architect, Town Hall.

BREDBURY (CHESHIRE).—Re-erection of portion of works, for the Bredbury Steel Works Co. (£3,000).

BRIGHTON.—Alterations to the "Red Lion," Park Place, for the Licensee.

BURTON LATIMER (NEAR KETTERING).—New Baptist Church; Trustees.

CHACETOWN (LICHFIELD).—Houses, Cross Street, Chase Terrace, for Churchill Bros. Additions to residence, for Dr. Horton.

CHATHAM.—Alterations, 199-203, High Street, for A. J. Whitehead.

CHESTERFIELD.—Boiler-house, Holme Brook Works, for Robinson & Sons, Ltd. Additions to store, Welshpool Pottery, Barker Lane, for Knowles & Son.

CLIFTON (NEAR MANCHESTER).—Additional surface buildings (with electrical installations), at Astley Green Collieries; Clifton & Kersley Coal Co., Ltd.

COVENTRY.—New schools, for Trustees, Gosford Street Baptist Church.

COWES (I.O.W.).—Houses, Park Road; J. Ball & Son, builders, Victoria Road.

DAGENHAM (ROMFORD).—Extensions, for the Sterling Telephone Co.

GLASGOW.—Rebuilding of bonded stores, for the Distilleries Co., Ltd. (£150,000).

GOVAN.—Secondary school; M. Adam, architect, 160, Hope Street, Glasgow.

GRANGEMOUTH.—Extension of shipbuilding yard, for Greenock & Grangemouth Dockyard Co., Ltd.; Manager.

HANDSWORTH.—Cannon Street Memorial Baptist Church, Holyhead Road; Trustees.

HAWICK.—Anderson Sanatorium, additions (£1,500); Clerk, Anderson Sanatorium.

HECKMONDWIKE.—Re-erection of works, Beck Lane, for the Spencer Wire Co., Ltd., & Gills, Ltd.; H. Spivey, owner.

HUDDERSFIELD.—New premises, for St. Saviour's Mission, Leeds Road North; Rev. A. Whorlow, Vicar of Parish.

IRLAM.—Extensions; Partington Steel & Iron Co., Ltd.

ILKLEY.—Primitive Methodist Church Sunday Schools; W. G. Smithson, architect, 2, Basinghall Square, Leeds.

KENMARE (Co. KERRY).—Rectory house; G. A. E. Hickson, architect, 23, Denny Street, Tralee.

KINGSTON-ON-THAMES.—Extensions to works, for Sopwith's Aeroplane Co.

LEEDS.—Additions to Mount St. Mary's Roman Catholic Church; Rector.

LONDON (BERMONDSEY, S.E.).—Temporary wards at the Princess Club Red Cross Hospital, Jamaica Road; J. Carmichael, builder, 331, Trinity Road, Wandsworth Common, S.W.
(LEWISHAM, S.E.).—Houses, Arran Road, Catford; J. Watt, builder, Bromley Road, Catford.
(ILFORD, E.).—Houses, Hickling Road, for A. Burch. Granary, etc., Oakfield Road and High Road; Banks, Martin Hammond & Co., architects. Garage, Balfour Road; Hammond & Miles, builders.
(BARNES, S.W.).—Additions to Sheen Lane Picturedrome; R. B. Rowell. Residence, Bracken Gardens; Hooper Bros. Flats, Castleton Mansions, River View Gardens; Peppiatt & Cooper. Business premises, Upper Richmond Road; Hunt & Jones.
(S.W.).—Rebuilding 25 and 27, Buckingham Palace Road; L. Martin, architect, Seymour House, Waterloo Place, S.W. Building, 2, Little Smith Street; Creed & Heal, architects, 5, Verulam Buildings, Gray's Inn Road, W.C.

MANCHESTER.—St. Dunstan's Roman Catholic School, Bluestone Road, Moston; Rev. Father Routledge. Renovation of Lumb Mill, Droylesden, for McConnell & Co., Ltd., cotton spinners.

NORTHAMPTON.—Alterations for R. W. Sharpe, 29, Abington Street.

NORWICH.—Extensions, St. George's Bridge, for Howlett & White, Ltd.

OSWALDTWISTLE.—Refuse destructor; Surveyor to U.D.C.

OTLEY.—Alterations, for W. Sinclair & Sons, Albert Works. Garage at Beech Hill, Otley, for H. Stephenson.

PATRICROFT (NEAR MANCHESTER).—Rebuilding sewing cotton mills; Erman and Roby, Cawdor Street Mills.

PENDLEBURY.—Additional electrical installations at local collieries; A. Knowles & Sons, Ltd., colliery proprietors.

PUDSEY.—Reinstatement of premises at Union Bridge Mills, for Gerald, Hartley & Co., Ltd.

RADCLIFFE.—Extensions; Radcliffe & Pilkington Co-operative Society.

RICHMOND (YORKS.).—Alterations to "The Board," High Road, for R. V. Kirtley.

ROTHERHAM.—52 houses, Thorpe Hesley, Wentworth, for Newton, Chambers & Co., Ltd., Thorncliffe Ironworks, Sheffield.

SCARBOROUGH.—Wesleyan Church (£8,000), Queen Street; Withers and Meredith, architects, London.

SCOTSWOOD-ON-TYNE.—New St. Margaret's Church; Rev. E. C. Harris, Curate-in-charge.

SEAMER.—Additions at the Seamer Auction Mart; C. H. Channon, architect, Malton.

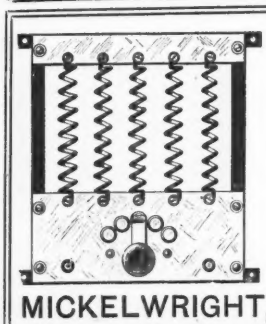
SOUTHEND-ON-SEA.—Additions, 40, Prittlewell Street, for C. Floyd. Houses, North Avenue, for F. H. Farnborough. Bungalows, Leigh Hall Road, for H. Bridge; Marguerite Drive, for S. C. Arnold; Hamstel Road, for J. J. Going; and Blenheim Crescent, for S. Sharp.

STALYBRIDGE.—Rebuilding cotton mills in Quarry Street; R. Platt, Ltd.

THORNABY-ON-TEES.—Re-erection of portion of works, for the Tees Bone Mill Co.

WEST THURROCK (GRAYS).—Houses; Carter & Co., builders, Grays.

WIGAN.—Rebuilding of winding house at Wigan Junction Colliery, Abram.



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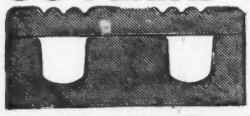
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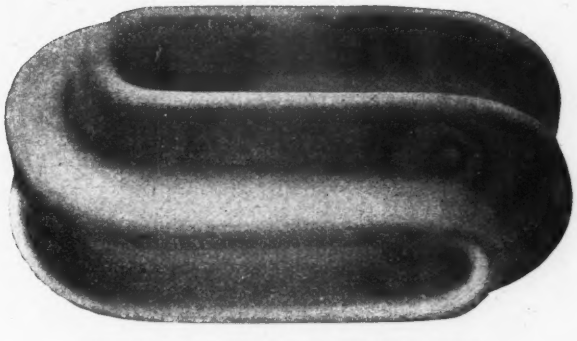

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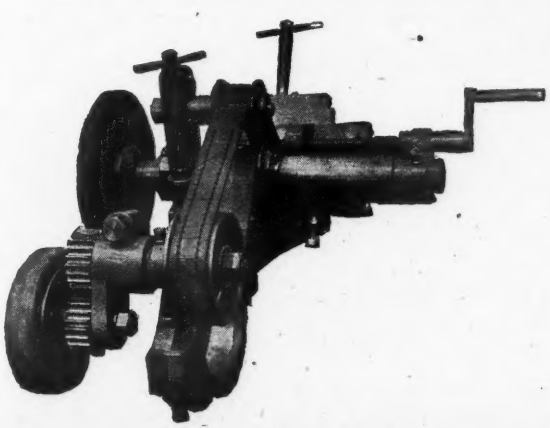

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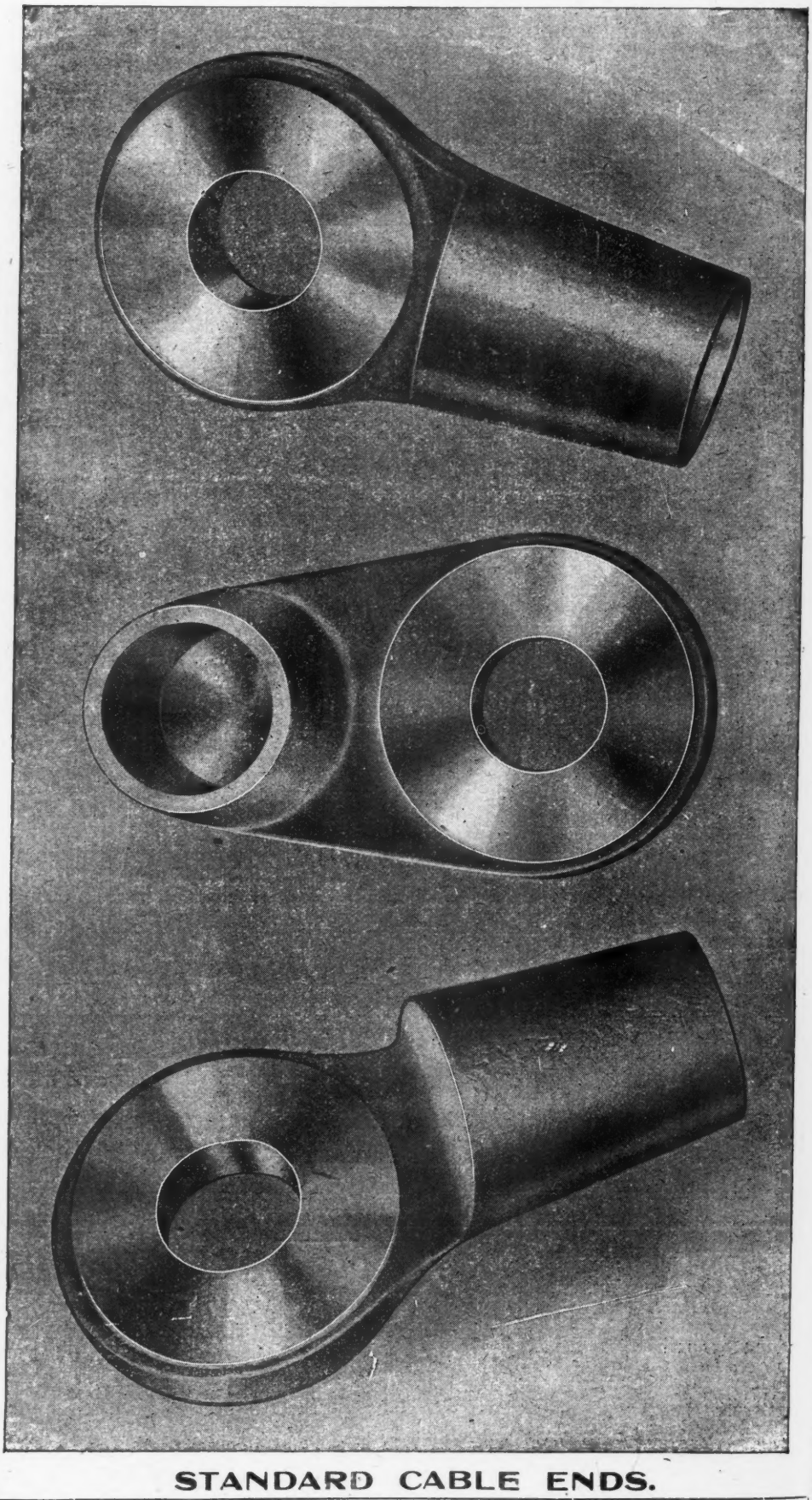

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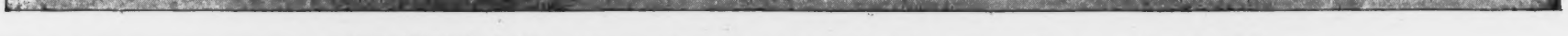

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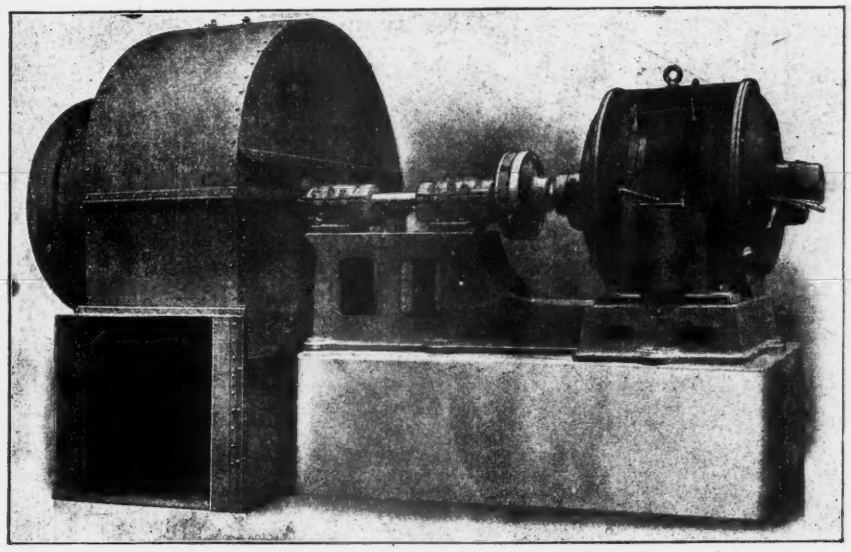

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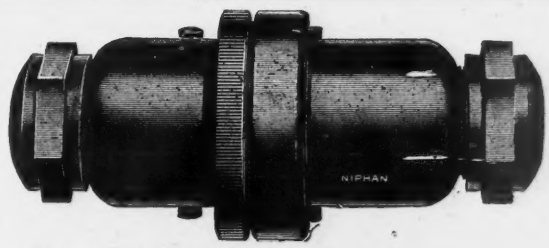

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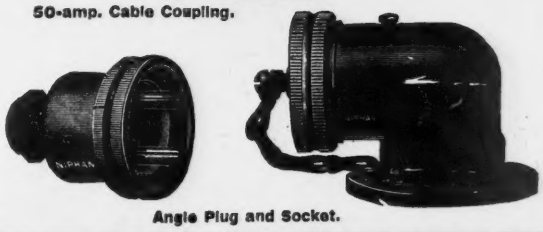

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